

*February 2003 - DRAFT*

# **U.S. Department of Energy**



## **Cost and Schedule Estimating Guide**

## **DOE Cost and Schedule Estimating Guide – DRAFT February 2003**

### **FOREWORD**

The mission of the Department of Energy's (DOE's) Office of Engineering and Construction Management (OECM) is: to drive value-added change in DOE project and facilities management systems, to provide corporate processes for the oversight of DOE projects and real property, to integrate sound fiscal acquisition and business practices into the management of projects and facilities, and to support DOE project managers. To attain this objective, DOE must maintain supportable, verifiable, and accurate cost and schedule estimates for programs and projects. The DOE Cost and Schedule Estimating Guide provides a basic framework for establishing and maintaining cost and schedule estimates, for implementing of several DOE Orders.

Today's cost estimates and schedules must effectively represent program and project requirements essential to achieve mission success. Successful project execution requires both well-defined and integrated scope, cost, and schedule elements.

Practitioners regard cost and schedule estimating as a cross between an art and science. The intent of this guide is to provide suggested practices and processes to improve the quality, reliability, and consistency of the DOE's cost and schedule estimates.

As it becomes necessary, this guide will be re-assessed and updated to reflect the latest industry developments. The DOE-Cost Engineering Group (DOE-CEG) is responsible for maintaining the information contained in the Cost and Schedule Estimating Guide.

The Office of Engineering and Construction Management (OECM)

Cost Engineering: T. Ross Hallman, DOE/NETL; Phone 304-285-4837

Value Engineering: Terry Brennan, DOE/NETL; Phone 412-386-5989

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

### Table of Contents

Chapter	Contents	Page
FOREWORD		2
2. DOE BUSINESS PROCESSES	2.1 - Program Strategic Planning 2.2 - Acquisition Planning 2.3 - Contracting 2.4 - Budgeting 2.5 - Project Assessment and Reporting	8
3. REQUIREMENTS	3.1 - Federal Requirements 3.2 - DOE Requirements 3.3 - Industry Standards 3.4 - DOE Program Office and Field Office Requirements	13
4. COST ESTIMATING	4.1 - Cost Estimate Requirements 4.2 - Cost Estimate Types 4.3 - Cost Estimate Methods 4.4 - Cost Estimate Processes 4.4.1 - Information Gathering	17

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

	4.4.2 - Estimate Production and Documentation 4.4.3 - Internal Cost Estimate Reviews 4.4.4 - External Cost Estimate Reviews 4.5 - Cost Estimate Contents 4.5.1 - Direct Costs 4.5.2 - Indirect Costs 4.5.3 - Allowances, Contingency, and Management Reserve 4.5.4 - Escalation 4.5.5 - Other Project Costs 4.6 - Cost Estimate Ranges	
5. SCHEDULING	5.1 - Schedule Requirements 5.2 - Schedule Types 5.3 - Schedule Presentation 5.4 - Schedule Elements 5.5 - Schedule Contingency 5.6 - Schedule Process 5.7 - Schedule Baseline 5.8 - Schedule Performance 5.9 - Schedule Reviews	46
6. REVIEWS	6.1 - Internal Reviews 6.2 - External Reviews	56

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

	6.3 - Cost Estimate Quality Objectives, Criteria, and Measures 6.4 - Historical Cost Data and Lessons Learned	
7. OTHER RELATED TOPICS	7.1 - Value Engineering 7.2 - Work Breakdown Structure and Code Of Accounts 7.3 - Cost and Schedule Estimating Tools 7.4 - Life-Cycle Costing 7.5 - Activity-Based Costing (ABC) 7.6 - TEC / OPC / TPC (APB) 7.7 - Breaches 7.8 - Earned Value	60
8. EXAMPLES	8.1 - Calculation and Use of Escalation 8.2 - Calculation and Use of Contingency 8.3 - Use of Life-Cycle Cost Analysis (LCA) 8.4 - Use of Activity-Based Costing (ABC) and Level-of-Effort (LOE) Estimating	77
9. APPENDICES	9.1 - PARS Project Reporting Requirements and Procedures 9.2 - Review Criteria 9.3 - Cost Estimate Review Checklist	110

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

	9.4 - Construction COA (Uniformat II) 9.5 - Alternative Construction COA (Masterformat) 9.6 - Environmental Management COA (ECES) 9.7 - TEC/OPC/TPC (APB) 9.8 - Capital Asset Plan (Exhibit 300) OMB A-11 9.9 - AACE Recommended Practice No. 17R-97	
10. REFERENCES	10.1 - Acronyms 10.2 - Definitions 10.3 - References	148

## **Chapter 1 - INTRODUCTION**

The objective of this guide is to improve the quality of cost and schedule estimates, and to further strengthen DOE programs and projects. This guide strives to achieve this objective by providing cost estimating principles and processes that are consistent with Federal, DOE, and industry standards, and that meet local requirements. This includes requirements of DOE Order 430.1, Life-Cycle Asset Management (LCAM), which emphasizes the management of a project or program throughout its entire life-cycle, and DOE Order 413.3, Program and Project Management for the Acquisition of Capital Assets, which emphasizes *successful projects*.

This guide is an evolution of DOE G 430.1-1 Cost Estimating (5/97), the Volume 6 Cost Guide (11/94), and its preceding six volumes of MA-0063 (c. 1984). This guide incorporates the life-cycle concept, and is applicable to both the traditional projects (construction, line-item-type), and the less-traditional projects (operations, expense-funded). This guide also incorporates useful information found in other Federal agencies and the private sector. This guide also gives consideration to the findings of past reports of the General Accounting Office, the DOE Office of the Inspector General, and the National Academies, Board on Infrastructure and the Constructed Environment.

This guide is intended to be used by Federal and contracting cost and schedule estimators, project managers, program managers, procurement and budget / finance employees, and any other personnel involved in the acquisition and operations of DOE facilities. This should ensure a consistent and standard approach to cost and schedule estimating, and should assure their reliability, supporting DOE projects and programs. Each prime DOE contractor, DOE field office, and DOE program office should incorporate these guidelines into their operating procedures to ensure consistency and standardization across the DOE.

## **Chapter 2 - DOE Business Processes**

Section 2.1 - Program Strategic Planning

Section 2.2 - Acquisition Planning

Section 2.3 - Contracting

Section 2.4 - Budgeting

Section 2.5 - Project Assessment and Reporting

One common aspect among the processes to be described in this chapter is the necessity of cost and schedule estimate information (data field, data elements, forms, analyses, etc.). As time evolves, these systems will become more integrated, and professionals will become better educated on specific requirements and uses.

DOE Order 413.3, along with other requirements, aid in applying the systematic approaches to establishing budgets and contracts. The Project Management Critical Decision (CD) Process assures rigor in program and project decision-making. Figure 2-1 illustrates requirements for cost estimates in relation to the CD Process.

### Project Critical Decision Process Requirements

CD-0 – Approve mission need. To support a CD-0, there should be a cost and schedule estimate (range) with level of confidence depicted on the Mission Need statement. This should be supportable with cost and schedule estimates, normally expected to be of a parametric nature, including contingency commensurate with the level of planning, and the project size and complexity. Ranges should be presented, representing levels of confidence.

CD-1 – Approve system requirements and alternatives (preliminary baseline). To support CD-1, cost and schedule estimates should be prepared to support a preliminary baseline, that is, a pretty good idea of what the baseline will be. The range presented should consider known alternatives and levels of confidence planned.

CD-2 – Acquisition Performance baseline (APB). The APB is the baseline managed, and to which integrated project teams and Federal project managers are held accountable. Cost and schedule estimates should reflect a very well-planned project, including a strong understanding of project risks to be encountered.

## **DOE Cost and Schedule Estimating Guide – DRAFT February 2003**

CD-3 - Construction start. For CD-3, there should be some confirmation of the APB, changes to date, and further analysis of risks to be encountered during construction or execution of the project.

CD-4 - Completion / closeout. At CD-4, there should be some indication of performance by the Integrated Project Team (IPT). New cost and schedule estimates are not necessary, but there should be some analysis of cost and schedule performance. That information should be maintained as historical cost information or Lessons Learned. Currently, there is no central DOE repository for that information, but one may be developed in the future. A standardized Work Breakdown Structure (WBS) and Code of Accounts (COA) will facilitate that development.

### **Section 2.1 - Program Strategic Planning**

Each DOE program has a unique mission. DOE programs consist of projects and operations that strive to achieve their missions. Missions normally cover multiple-year goals and require much up-front planning. Each DOE program should have some form of strategic planning (both projects and operations), and should be supported, in general, by cost and schedule estimates.

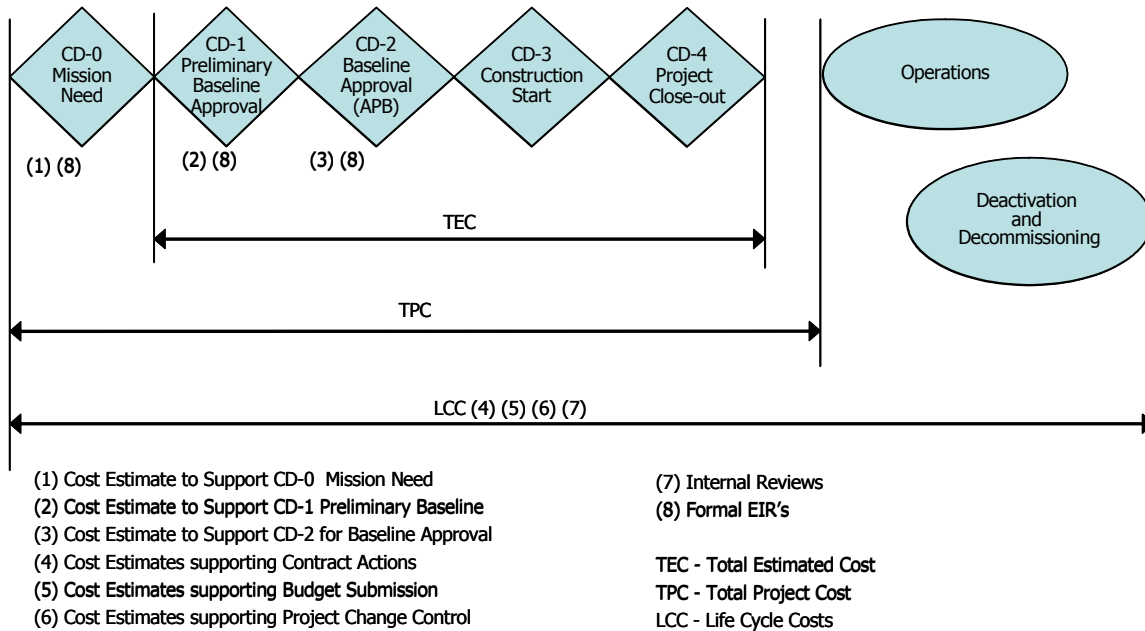
For planning purposes, as missions are established and projects / operations are conceived, several key documents are developed to help program managers remain focused on the program's mission. Some key strategic planning documents include: the Acquisition Strategy, the Acquisition Plan, the Project Execution Plan, and the Risk Management Plan.

Also, each DOE program office and operations / field / site office is unique. Each has local labor agreements, safety and health issues, and other unique considerations which must be planned and managed appropriately. Therefore, each program and field office should consider cost and schedule estimating requirements carefully in assuring that their budgets, contracts, and projects are well-documented, and appropriately representative of their unique situations.

### **Section 2.2 - Acquisition Planning**

DOE program offices are responsible for planning acquisitions for respective projects. Acquisition strategies, as required for CD-0, should be a programmatic attempt at integration. That is to say, all projects and operations within a program should be related by the program mission, and logically tied to accomplishing the mission. Figure 2-1 illustrates the cost and schedule estimates in the project life cycle.

**Figure 2-1. Cost and Schedule Estimate Requirements  
in the Project Life-Cycle**



## Section 2.3 - Contracting

In order to fulfill their mission needs, DOE programs and projects are responsible for the planning and procurement of contracts. Performance-Based contracting requires discrete, quantifiable, and measurable objectives tied to incentive fee. A project baseline (established at CD-2) and near-term contracts, or work packages, should also have characteristics that are discrete, quantifiable, and measurable.

Also, there is a need for government estimates prior to any contracting activity. Generally, the government should have an idea of how much something should cost and how long it should take to accomplish, prior to asking a contractor for that information. That knowledge, or government estimate, may become the basis for contract negotiations, or become important in the case of settling claims.

## Section 2.4 - Budgeting

The Office of Management and Budget directs that the executive branch Federal agencies submit budgets to Congress for approval. Performance-Based budgeting, similar to Performance-Based contracting, requires discrete,

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

quantifiable, and measurable objectives tied to budgets (i.e. funding). Cost estimates that support budgeting processes are required for validation. Both the development and validation of these cost estimates are the responsibility of the DOE program and field offices. Also, budgets are required for validation annually. Budgets for projects are recorded by OMB, and are submitted on Exhibit B-300 forms (see Appendix 9.8).

### **Section 2.5 – Project Assessment and Reporting**

In a DOE Memorandum, dated September 19, 2001, the Deputy Secretary directed the Office of Management and Budget Execution (OMBE) to begin issuing monthly reports on acquisition projects. This direction, passed on to all departmental elements and clarified in memos, dated September 22 and September 26, 2001, requires the use of the Project Assessment and Reporting System (PARS) for all capital acquisitions. PARS reporting requirements are available in Appendix 9.1, and can also be seen on the PARS website at <https://pars.energy.gov/>.

#### PARS Project Size Designations

For projects reported in PARS, project size designations are Major Systems, which are projects greater than \$400M, and Non-Major Systems, projects greater than \$20M and less than \$400M. Earned Value Management System (EVMS) is required for any project over \$20M, and all projects less than \$20 million that use EVMS are required to report data in PARS.

#### PARS Project Types

For projects reported in PARS, there are seven project categories, or types, as follows:

- 1) Systems
- 2) Facility Construction
- 3) Infrastructure Improvements
- 4) Environmental Restoration
- 5) Disposition
- 6) Information Technology
- 7) Plant

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Performance indices, such as the Cost Performance Index and Schedule Performance Index (CPI and SPI) are commonly used for project assessment. To assist senior management with interpreting the range of values, color thresholds have been created for the categorization of projects. These thresholds are based on cumulative, or project-to-date, cost and schedule performance indices (CPI-PTD and SPI-PTD), and are assessed on projects that are beyond the definition stage. Generally, an index value less than 1.0 is unfavorable, and a value greater than 1.0 is favorable. The current guidelines for the color coding are:

GREEN	CPI-PTD or SPI-PTD between .9 and 1.15
YELLOW	CPI-PTD or SPI-PTD between .85 and .89, or between 1.15 and 1.25.  PARS Project data not updated within the past 45 days
RED	CPI-PTD or SPI-PTD below .85, or above 1.25

### **Chapter 3 - REQUIREMENTS**

Section 3.1 - Federal Requirements

Section 3.2 - DOE Requirements

Section 3.3 - Industry Standards

Section 3.4 - DOE Program Office and Field Office Requirements

In determining cost and schedule estimating requirements, it is important to understand the hierarchy of requirements described in this chapter.

#### **Section 3.1 - Federal Requirements**

The Federal government has requirements for cost and schedule estimates, which are contained in the Federal Acquisition Regulation (FAR), Office of Management and Budget (OMB) Circulars, and the Code of Federal Regulation (CFR). These requirements set standards for things such as government estimates, Cost and Price Analysis, and Life-Cycle Cost Analysis (LCCA) can be used in contracting, budgeting, alternative analyses, and project / program management. Primarily, these are keys in determining that the government is receiving a fair price for goods and services, and assuring that long-term costs are being considered in the decision-making process.

The Federal Acquisition Regulation (FAR) has numerous references to cost and schedule estimates. Specific requirements address government estimates, such as Cost and Price Analysis, and Should-Cost Analysis. The FAR also addresses appropriate categorization of costs (direct / indirect), uses of contract types, and fee determination.

The OMB Circulars submits requirements for planning and managing acquisition of capital assets, discount rates to be used in LCCA, and value engineering (VE). Specifically, OMB requires the submission of Exhibit 300, and the use of earned value (EV) reporting, the use of risk management (risk-adjusted estimates), and the use of integrated project teams (IPT) per OMB A-11, Part 7. Other OMB Circulars and bulletins delineate the requirements for the development and audit of the federal agencies' annual financial statements.

The Code of Federal Regulation (CFR) contains requirements for the use of Life-Cycle Analysis (LCA) to determine the most cost-effective alternatives, regarding energy use, in particular. However, that requirement also has applicability to technology selection, site selection, method-of-accomplishment, contracting

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

strategy, etc. The CFR also provides requirements for performance standards to be used in planning and managing construction and operation of Federal facilities.

A list of applicable Federal requirements may be found in Section 10-3 - References.

### **Section 3.2 - DOE Requirements**

DOE requirements, following Federal requirements and other guidance sources provided to the executive branch of government, are documented in the DOE Directive System (<http://www.directives.doe.gov>). Generally, DOE's hierarchy of Departmental requirements is as follows: policies, orders, and guides. The DOE Cost and Schedule Estimating Guide may be found in this system. This supercedes DOE G 430.1-1 Cost Estimating (formerly known as the Volume 6 Cost Guide, last revised in 1994/1997) and is a companion document to the Project Management Manual and Practices (PMMP).

DOE Orders are written to fulfill Federal requirements and to implement policies. Some specific DOE Orders with requirements for cost and schedule estimates are:

- *DOE O 413.3 Program and Project Management for the Acquisition of Capital Assets* - Promotes the systematic acquisition of projects and emphasizes the necessity for managing successful projects. DOE O 413.3 defines particulars of the CD Process: establishing protocol, authorities, and consistency within the DOE programs.
- *DOE O 430.1 Life-Cycle Asset Management (LCAM)* - Promotes the management of a facility, from inception through design, construction, start-up, operation, transition, cleanup, and ultimate disposition. With the implementation of LCAM, contract systems have been transitioned from compliance-based to performance-based. This means that both LCA and LCCA should be used in the decision-making process for programs and projects.
- *DOE O 430.1b Real Property Asset Management, Draft (RPAM)* - Establishes a corporate, holistic and performance-based approach to real property life-cycle asset management that links real property asset planning, programming, budgeting and evaluation to program mission projections and performance outcomes. The implementation of RPAM will delete the requirements of LCAM, although most requirements for cost and schedule estimates and LCCA remain.
- *DOE O 130.1 Budget Formulation* - Establishes the processes for

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

developing, reviewing, and exchanging budget data. Among other things, DOE O 130.1 requires that budget formulation be performance-based, be in support of the DOE strategic plans, be measurable and verifiable, and be based on cost estimates deemed reasonable by the cognizant program and field offices.

- *DOE O 520.1 - Office of Chief Financial Officer* - Promotes the achievement of the objectives of the CFO Act: sound financial management policies and practices, effective internal controls, accurate and timely financial information, and well-qualified financial managers by setting forth the functions, organizational roles, and specific financial management responsibilities of the CFO, the field CFOs, and other appropriate DOE officials.
- *DOE O 534.1 Accounting* - Designates the requirements and responsibilities for the accounting and financial management of the DOE. Requirements include, but are not limited to, establishing a single, integrated financial management system that serves program management, budgetary, and accounting needs and ensuring that DOE and its integrated contractor records contain sufficient details in accounting for all DOE funds, assets, liabilities, and costs.
- *DOE O 542.1 Competition in Contracting* - Ensures compliance with the Competition In Contracting Act of 1994, the Federal Acquisition Streamlining Act of 1994, the Clinger-Cohn Act of 1996, the Federal Procurement Regulation (FAR) and other applicable laws and regulations. It also ensures that the acquisition of all goods and services, with certain exceptions as listed in FAR part 6.302, be made by full and open competition, and encourages the acquisition of commercial items.

Other DOE Orders involving environmental safety and health (ES&H), and security contain requirements which normally affect a project or program estimate costs. However, they do not directly impact processes for estimating those costs, formulating the budget for those costs, or for contracting for those activities. Cost estimators, schedulers, and project managers should be cognizant of all applicable DOE requirements.

### **Section 3.3 - Industry Standards**

Industry standards are not requirements. Because of the commercial nature of functional areas (cost estimating, scheduling, project management, etc.) and government commitment to incorporate commercial standards, the government should integrate commercial standards accordingly. In this context, the DOE has partnership agreements with organizations such as the Association for the

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Advancement of Cost Engineering, International (AACE) and Project Management Institute (PMI), to acknowledge and promote approaches to consistency and standardization. Therefore, where appropriate, this guide incorporates standards and recommended practices of these organizations.

The DOE and AACE Partnership Agreement, signed in 1997, promotes the ideals of effective project management, including the concept of total cost management. The DOE Cost and Schedule Estimating Guide is provided as guidance to implement both DOE and federal requirements. Regarding cost estimating requirements and the cost estimating types (see Chapter 4), DOE generally follows the AACE classification of cost estimate types (see Section 4.2 and Appendix 9.9). Also, there are standards for establishing estimates such as *Construction Industry Institute's Best Practices Guide* titled "Improving Early Estimates."

### **Section 3.4 - DOE Program Office and Field Office Requirements**

To facilitate the discreet missions of the DOE field, site, and area offices, other specific requirements may be implemented.

"Old" *DOE Order 5700.2d, Cost Estimating, Analysis, and Standardization*, included a requirement for each site to maintain cost estimating guidance, to be consistent with DOE headquarters. Since that DOE Order was deleted (phased out with the implementation of DOE O 430.1, LCAM), there is no existing requirement for this. However, it would be prudent for each DOE program and site to have some policy, requirement, or guidance to offer respective Federal project / program managers and contractors.

## **Chapter 4 - COST ESTIMATING**

Section 4.1 - Cost Estimate Requirements

Section 4.2 - Cost Estimate Types

Section 4.3 - Cost Estimate Methods

Section 4.4 - Cost Estimate Processes

Section 4.5 - Cost Estimate Contents

Section 4.6 - Cost Estimate Ranges

### **Section 4.1 - Cost Estimate Requirements**

DOE cost and schedule estimate requirements are derived from Federal requirements, DOE requirements (DOE Orders), and industry standards outlined in Chapter 3. These requirements include cost estimates and LCCA developed to support:

- 1 - CD Process within programs/projects (DOE O 430.1 and DOE O 413.3)
- 2 - Annual budget process (DOE O 130.1 Budget Formulation)
- 3 - Contract actions (DOE O 542.1 Competition in Contracting)
- 4 - Other project / program management decisions (various Federal regulations, DOE Orders, and industry practices). This includes the development of LCA, in particular for VE analyses, EV analysis, and support of Change Control.

### **Section 4.2 - Cost Estimate Types**

The cost estimate and schedule types are based on AACE's "Recommended Practice for Classifying Cost Estimates" (*AACE International Recommended Practice No. 17R-97*) in Appendix 9.9.

Cost estimates and schedules have common attributes, regardless of whether a technical scope is of a more traditional project (capital-funded construction-type), or a more non-traditional (expense-funded operations-type) project. These common attributes are levels of definition, requirements, and methods. Typically, as a project evolves it becomes more definitive. Cost and schedule estimates depicting these evolving projects, also become more definitive over time.

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

These cost estimate types may be used with any type of traditional or non-traditional project and includes consideration of:

- Where a project stands in its life-cycle
- Level of definition, or amount of information available
- Methods to be used in estimation, e.g. Parametric vs. Definitive
- Time constraints and other estimating variables

Determination of cost estimate types will help to assure that cost estimate *quality* is appropriately considered. Cost estimate types may also help determine: appropriate application of contingency, escalation, use of direct / indirect costs (as determined by cost estimate method), etc. Table 4-1 is a list of DOE cost estimate types.

<b>Table 4-1</b>			
<b>Cost Estimate Types</b>			
<b>Cost Estimate Types</b>	<b>Primary Characteristics</b>		
	<b>Level of Definition</b>  <b>(% of complete definition)</b>	<b>Examples of Use</b>	<b>Cost and Schedule Estimating Description (Methods)</b>
<b>Type 5</b>  <b>Also known as Order of Magnitude or Rough Order of Magnitude (ROM) Cost Estimates</b>	0% to 2%	<u>Support CD-0 Mission Need</u>	Stochastic, Most Parametric, Judgment (Parametric, Specific Analogy, Expert opinion, Trend Analysis)
<b>Type 4</b>	1% to 15%	NOT Required. Intermediate Check Estimate	Various, More Parametric (Parametric, Specific Analogy, Expert opinion,

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

			Trend Analysis)
<b>Type 3</b> <b>Also known as</b> <b>Budgetary or</b> <b>Preliminary</b> <b>Cost Estimates</b>	10% to 40%	<u>CD-1 Preliminary</u> <u>Baseline Approval</u>  <u>CD-2 Baseline</u> <u>Approval</u>	Various including combinations (Bottoms Up, Parametric, Specific Analogy, Expert Opinion, Trend Analysis)
<b>Type 2</b>	30% to 70%	NOT Required. Intermediate Check Estimate	Various, More Definitive (Bottoms Up, Expert Opinion, Learning Curve)
<b>Type 1</b> <b>Also known as</b> <b>Definitive Cost</b> <b>Estimates</b>	50% to 100%	<u>CD-3 Construction</u> <u>Start</u>	Deterministic, Most Definitive (Bottoms Up, Expert Opinion, Learning Curve)
Note: This table does not express expected accuracy level or preparation effort, since each is considered subjective.			

- **Type 5 – Order of Magnitude, Rough Order of Magnitude (ROM), or Top-Down Cost Estimates**

Type 5 – Order of Magnitude, Rough Order of Magnitude (ROM), or Top-Down cost estimates are typically performed in the early stages of a project life, typically those supporting a CD-0 mission need. These cost estimates are based on the least amount of available information, and may require a large range of confidence, or accuracy.



### Key Point

As a general rule, even for projects in early stages of development, it is prudent to indicate more definitive scope development for near-term portions of work.

For instance, cost and schedule estimates supporting a CD-0 may include:

- Definitive estimates and scope for near-term
- Better-defined work (e.g. the design and scope development stages), and more parametric estimates for the long-term
- Less-defined work (execution / construction / project close-out stages)

- **Type 3 – Budgetary or Preliminary Cost Estimates**

Type 3 – Budgetary or preliminary cost estimates are those typically required to support a CD-1 preliminary baseline. These cost estimates are those that contain diverse levels of available and supporting information, use various methods for development, and portray a moderate range of confidence.

- **Type 1 – Definitive, Detailed, or Bottoms-Up Cost Estimates**

Type 1 – Definitive, Detailed, or Bottoms-Up cost estimates are those with the most abundantly available support information typically using a definitive method for development, representing a smaller range of confidence.

### **Section 4.3 - Cost Estimate Methods**

Several cost and schedule estimating methods are available to facilitate the cost and schedule estimating process. Dependent upon project scope, estimate purpose, and availability of cost and schedule estimating resources, the estimator may choose one, or a combination of these techniques. Each cost estimating method may generally follow the example in Section 8.4, regarding ABC and LOE, for use, format, and calculation. The following is a list of methods that may be employed in developing cost estimates:

### 1. Bottoms-Up

The Bottoms-Up is one of the more commonly understood and utilized estimating methods. Its accuracy depends on the accuracy of available information. Bottoms-Up estimates are the most definitive of the estimate methodologies and use information down to the lowest level of detail available. A work statement and set of drawings or specifications are used to identify activities that make up the project. Each activity is further broken down so that labor, materials, equipment, and subcontract costs (or other unit-cost-type items) are itemized and quantified. Quantities and resources are identified. Using these quantities and resources, productivity, material costs, and equipment usage are estimated. Subtotaled, these form direct costs. Indirect costs, overhead costs, contingency, and escalation are then added, as necessary. The estimate may be continually revised as the known detail is refined. The Bottoms Up estimating method is most used for the Types 4 and 5, the more definitive cost estimates.

Bottoms-up estimating is synonymous with Activity-Based Costing (ABC). Examples of ABC and LOE estimates may be found in Section 8.4.

### 2. Parametric, or Top-Down

Parametric estimating produces higher-level estimates when little information, other than basic parameters, is known about a project. For example, a building's cost can be estimated given only its size, purpose, and general site information. A Parametric estimate requires the use of Cost Estimating Relationships (CER, also known as cost models, composites, or assemblies / sub-assemblies), which are developed from historical data by similar systems or subsystems. CERs are correlations between cost drivers and system parameters, such as design, or performance requirements. A CER can be used individually, or grouped into more complex models. Parametric estimates are commonly used in conceptual and check estimates, and are normally developed using computerized software. A limitation of the use of CERs is that, to be most effective, one must understand completely how the CER was developed, and where and how indirect costs, overhead costs, contingency, and escalation are applicable. The Parametric estimating method is most appropriate for the Types 5, 4, and 3 ROM and preliminary cost estimates.

### 3. Specific Analogy

Specific analogies use the known cost or schedule of an item, as an estimate for a similar item in a new system. Adjustments are made to known costs and schedules to account for differences in relative complexities of performance, design, and operational characteristics.

A variation of this method is the "review and update" technique" where an estimate is constructed by examining previous estimates of the same or similar projects for logic, scope completeness, assumptions, and other estimating methodologies, and then updated to reflect any pertinent differences. The Specific Analogy cost estimating method is most appropriate in the early stages of a project, for Types 5, 4, and 3, ROM and preliminary cost estimates.

### 4. Expert Opinion

Expert Opinion is an estimating method whereby specialists are consulted until a consensus can be established, regarding the cost and schedule of a program, project, sub-project, task, or activity.

A formalized procedure, called the Oracle Methodology, has been used to forecast cost based on Expert Opinion. Six or more experts are given a specific, usually quantifiable, question. Each expert sees the estimates of each of the others, then modifies his previous estimate. If no consensus is reached after four rounds, the original question may be broken into smaller questions for further rounds of discussion, or a moderator may attempt to produce a final estimate.

This method maybe used for entire estimates, or portions of estimates, including activities for which there is no other sound basis. A limitation may be the instance where a cost estimators or project manager's status as an "expert" is questioned.

### 5. Trend Analysis

Trend Analysis is an estimating method utilizing current, in-progress work. A trend is established using an efficiency index derived by comparing originally planned costs (or schedules) against actual costs (or schedules) for work performed-to-date. The derived cost / schedule indices are used to adjust estimate of work not yet completed. The Trend Analysis method of cost estimating may be used in most any stage of project development.

### 6. Learning Curve

The Learning Curve is a way to understand efficiency of large quantities. It has been studied and proven that people engaged in repetitive tasks will improve their performance over time – and for large quantities of time and units, labor / effort will decrease, per unit. The aircraft industry first recognized this fact, called it "the learning curve", and successfully utilized it in estimating. It can be used most effectively when new procedures are being fielded, and where labor cost is a significant percentage of total unit cost. But it should always be understood that the learning curve applies only to direct labor input - materials and overheads will not be affected by the learning curve. Figure 4-2 illustrates the theoretical use of the Learning Curve.

Typical learning curves start with high labor hours that decrease rapidly on initial units and then level out; illustrating a progressive improvement in productivity at a diminishing rate, the number of units produced increases. This exponential relationship between labor productivity and cumulative production is generally expressed in terms of labor reductions experienced when production is doubled. A 90% Learning Curve function requires only 90 percent of the labor hours per unit each time production doubles. When a total of 200 units are produced, labor costs for the second hundred will be only nine tenths of the cost of the first hundred units.

Increased productivity allows for lower labor costs later in a project, and thus will lower overall project costs. Subsequent similar projects should have fewer labor hours for each unit of production also; this allows for more contractor profit and lower government contract costs.

No standard reduction rate applies to all programs, however, and learning curve benefits will vary. When labor hour reductions of the first units are known, an accurate percentage reduction can be calculated and extended to subsequent units. If no data exists, it may be risky to assume that learning curve savings will be experienced.

The Learning Curve Estimating method is applicable for consideration in all traditional and non-traditional projects. The Learning Curve has been proven to be effective in the most repetitive projects and activities.

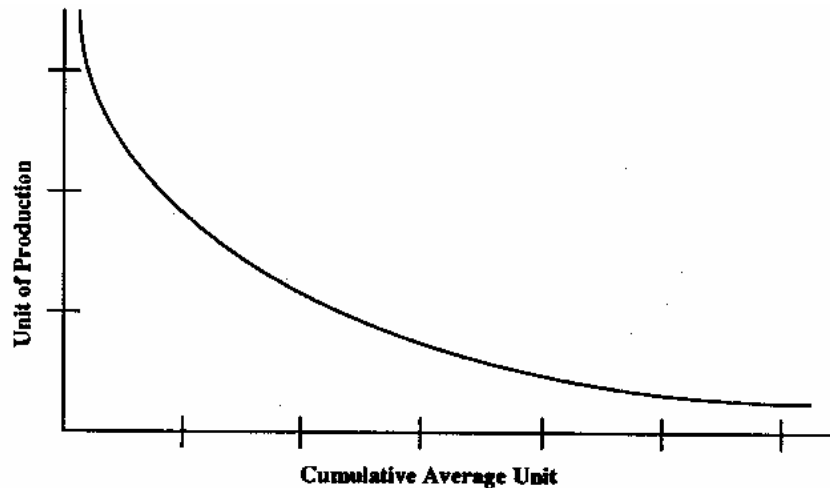


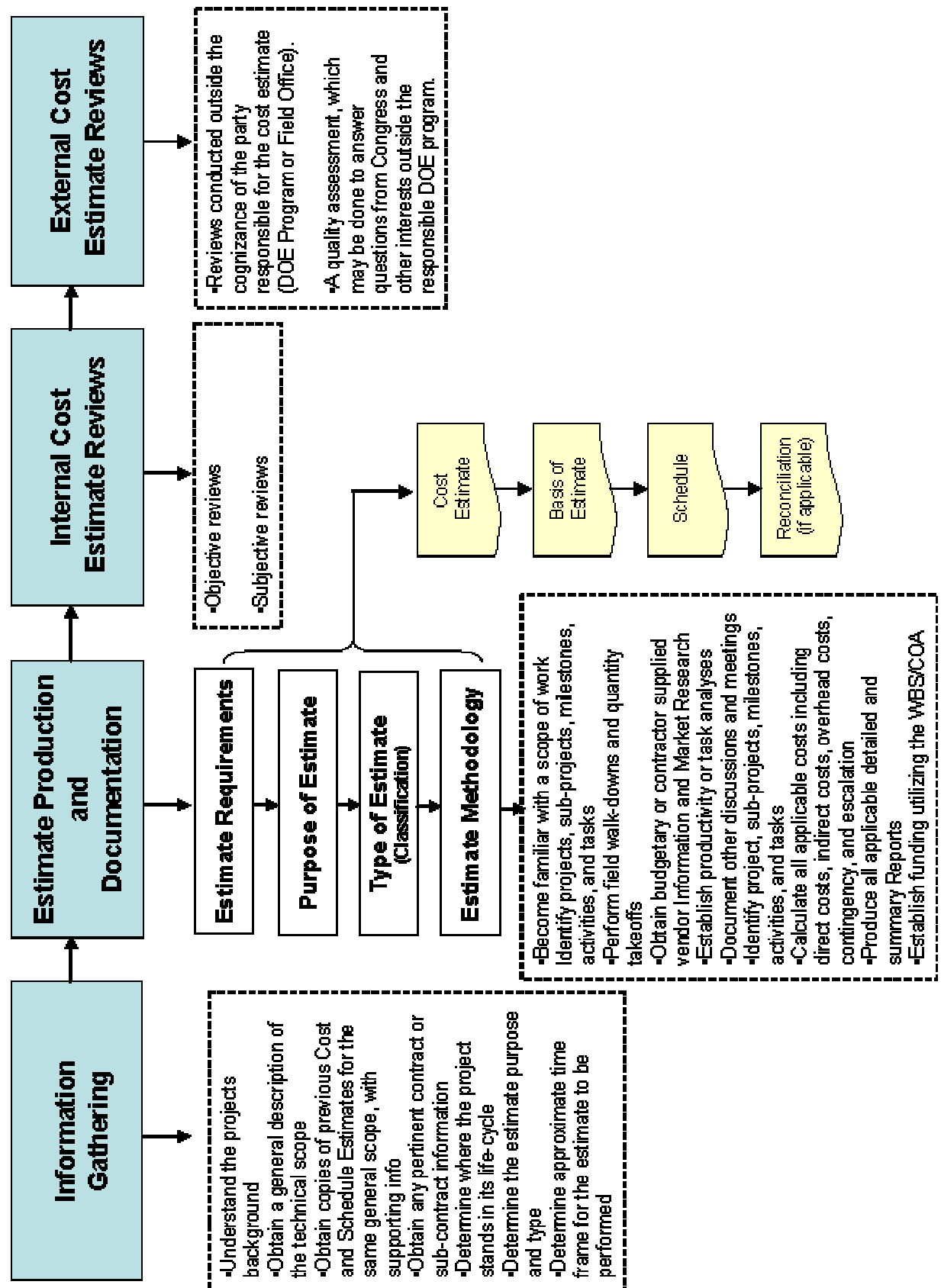
Figure 4-2. Learning Curve

#### **Section 4.4 - Cost Estimating Process**

In producing a cost and schedule estimate, a systematic process is necessary to ensure consistency and quality. Each DOE program and field office has primary responsibility of validated and supported budgets and contract actions. A systematic process is necessary for any cost and schedule estimate to have substantial credibility, regardless of the type or purpose.

When estimating the cost of a project, an estimator needs to know more than just quantities and prices per quantity to develop a good estimate. When developing an estimate, the estimator should produce a package consisting of a cost estimate, a schedule, and a basis of the estimate, all of which should be cross-referenced (by a WBS and/or COA) to ensure consistency. The cost and schedule estimate is a document to be used by the project or program for specific purposes, as described earlier. This chapter focuses on the steps in establishing an estimate, in order to assure a high degree of quality. More details of the estimate contents and estimate quality can be found in Section 4.5 and Section 6.3. Figure 4-1 is a general illustration of the cost estimating process.

## Cost Estimating Process





### **4.4.1 Information Gathering**

When given the task to develop an estimate, an estimator must first:

- Understand the project background
- Obtain a general description of the technical scope
- Obtain copies of previous cost and schedule estimates for the same general scope, with supporting info
- Obtain any pertinent contract or sub-contract information
- Determine where the project stands in its life-cycle
- Determine the estimate purpose and type
- Determine approximate time frame for the estimate to be performed

From this information, whether provided by others, or developed by the estimator as an assumption, the appropriate estimating methods needed may be determined.

### **4.4.2 Estimate Production and Documentation**

This second step in the estimating process is the production of the cost estimate, and its corresponding schedule, and basis of estimate. This includes such things as:

- Become familiar with a scope of work. Identify project, sub-projects, milestones, activities, and tasks
- Perform quantity-takeoffs and field walk-downs
- Obtain budgetary or contract supplied vendor information and market research
- Establish productivity or task analyses
- Calculate all applicable costs including direct costs, indirect costs, overhead costs, profit, contingency, and escalation
- Produce all applicable detail and summary reports
- Establish a funding profile utilizing the WBS / COA

All of this should be done, considering the requirements, the purpose, the type

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

(classification), and chosen methodology for the cost estimate. Ultimately, the cost and schedule estimates should be commensurate with the project size, complexity, and life-cycle stage.

A well-documented estimate withstands scrutiny. If rigorous documentation and estimate procedures are followed, the credibility of a project cost and schedule estimate increases. It is important to document all steps of the Cost Estimating Process. The particulars of performing a cost estimate may vary, depending on historical perspectives, professional judgment, resources available, and DOE Program / Field Office idiosyncrasies. As a minimum, the following items should be considered as estimate documentation:

### 1. Cost Estimate

A cost estimate should typically contain discrete elements for direct costs, indirect costs, contingency, and escalation. Detailed and summary estimate information should be arranged by WBS and fiscal year, within the period of performance. Information should clearly include: quantity, production rate, total labor hours, labor category, labor rate (typically including direct hourly labor rates, fringes, and labor burden), total labor cost, material unit cost, total material cost, subcontract unit cost, subcontract total cost, and the cost element total. These items should be included and commensurate with the available technical scope.

The estimate should be done whereby duplication or checking is systematic, or verifiable.

Worksheets, calculations, and other pertinent documentation should be kept well organized. Documentation should include the following:

- Definition of what is included in the TEC / OPC / TPC (APB)
- Description of cost estimate methods, quantities, applicable rates, and encompassing sources of information such as historical costs, industry standards, published price lists, cost databases, informal budgetary information, and CERs, etc.
- Description of start-up and operating costs
- Description of calculated contingency that may include, or reference a Risk Analysis
- Description of calculated escalation
- Estimate history, or cost estimate log, if there is a revision to an existing estimate or a change order estimate

## **DOE Cost and Schedule Estimating Guide – DRAFT February 2003**

- The name, signature and/or initials of the preparer and reviewer of the cost estimate

### **2. Basis Of Estimate**

A narrative basis of estimate should typically contain: assumptions made to produce the estimate, sources of information (i.e. historical information, industry standards, quoted budgetary information, commercially available catalogue price lists, etc.), and any particular information which would support a determination of reasonableness and/or a cost estimate reproduction by an independent third party.

- Cost estimate purpose and type
- WBS / COA, scope of work, including deliverables
- Project / program requirements and milestones, including constraints, special conditions, regulatory drivers, applicable DOE Orders, and industry standards
- Description of exclusions
- Backup data, including quantity takeoffs, calculations, commercial databases, historical data, CERs, quotes, and other general sources of information
- Basis of direct and indirect costs, escalation, and contingency

### **3. Schedule**

Scheduling is included with the cost estimate documentation, and directly relates to the process, and is addressed in Chapter 5.

### **4. Reconciliation**

Reconciliation may be necessary to account for changes made between Critical Decisions or other life-cycle project milestones. Reconciliations should be organized by WBS and cover aspects of project documentation. In general, reconciliation should recognize or highlight specific changes in scope, or basis for the cost estimate and schedule. There should be an understanding that as time progresses, more and better information is expected to be available and used as project documentation.

#### **4.4.3 Internal Cost Estimate Reviews**

The third step in the cost estimating process is an internal review of the cost estimate for quality aspects, prior to its final intended use. This review is internal to a program or field office and should be used as a means of assuring quality. An objective approach to cost estimate quality will result in a measure of performance. This topic is also discussed in Section 6.3.

There are two primary methods of review: objective and subjective reviews.

*Objective reviews* normally consist of a very structured approach, such as a checklist with some type of grading system which addresses consistency about projects estimated, or procedures followed. Objective reviews may also indicate a minimum acceptable level of quality.

*Subjective reviews* are normally less structured and may address areas differently, depending on various levels of emphasis. Internal reviews may be a combination of objective and subjective criteria and, but should be performed consistently between projects within a program, to the most practical extent.

As a minimum, internal and external cost estimate reviews should address the eleven minimum review criteria depicted in Section 6.1.

#### **4.4.4 External Cost Estimate Reviews**

The last step in the cost estimating process is not so much a step, but rather an acknowledgement, for external reviews. This includes reviews conducted outside the cognizance of the party responsible for the cost estimate (DOE program or field office). This is also a quality assessment, which may be performed to answer questions from Congress and other interests outside the responsible DOE program. Generally, these external reviews are a part of cost estimating guidance since (per LCAM and DOE O 413.3) it is a field office and contractor responsibility to coordinate these reviews. Specifically, External Independent Reviews (EIRs) are those project reviews mandated by Congress on specific projects. An EIR guide is available through OECM.

Similar to internal reviews, the external reviews may consist of both objective reviews (utilizing checklists or other specific criteria) and subjective reviews (informal criteria). Criteria used for these external reviews are based on the types of information, the purpose, and the time available. And since there are various reviewers, purposes, and types of projects to be reviewed, each review is normally specific to a project or program.

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

### Section 4.5 - Cost Estimate Contents

Cost and schedule estimates are normally systematically organized by a WBS, a COA, or some other standardized definition (e.g. CSI Divisions). Within this organization, costs are broken down into direct, indirect, contingency, and escalation costs. Standard definitions of direct and indirect costs provide consistency in estimating costs and project reporting. This also benefits program/project management, independent estimates (Government Estimates), reviews, and contract/project validations and cost/price analysis.

Figure 4-3 illustrates the segregation of capital and operating expenses. Each project should be unique in terms of specific activities that are required, although these general categories should be maintained to the most practical extent.

**TABLE 4-3  
RECOMMENDED GENERAL COST ALLOCATION MATRIX**

PROJECT DEVELOPMENT ACTIVITY	PROJECTS		
	OPERATING EXPENSE	CAPITAL EXPENSE	
		DESIGN	CONSTRUCTION
PED	X		
Title I - Preliminary Design		X	
Title II – Definitive Design		X	
Title III – As-Built, Quality Assurance, etc.		X	
Construction	X <sup>1</sup>		X
Construction Management			X
Project Management	X <sup>2</sup>	X <sup>2</sup>	X <sup>2</sup>
Project Support	X	X	X
Startup	X		
<sup>1</sup> Capital funding for betterments, conversions, and replacements. Alterations are may be funded by operating expense.			
<sup>2</sup> Project Management costs, during the design phases, of projects authorized <u>for design only</u> , are funded with PED funds.			

### Contract Type

Before determining the content of an estimate, it seems pertinent to discuss contract types. Contract type determines activities and cost accounts to be established. Contract types typically reflect a level of technical definition, size, and complexity of activities, and are based on a set scope of work. Fixed-Price contracts are normally best defined, and most readily competitive. A Cost-Reimbursable contract will indicate a

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

less-defined scope of work, may include more size and complexity, and may be less ready for competition. Contract type may be affected by a program acquisition strategy, but may also be specific to a particular project, or activities within a project.

Most DOE projects fall into the category of Cost-Reimbursable contracts. Generally, fee determination, in a Cost-Reimbursable (cost-plus) contract, distinguishes whether or not it is performance-based. Cost-Plus-a-Percentage-of-Cost contracts are typically not allowed for government work. Table 4-4 illustrates some common contract types and their respective elements. However, there may be variations to these contract types. These various contract types should be managed appropriately, commensurate with project size and complexity.

Common to DOE's large contracts are the Management and Operating (M&O) contracts and the Management and Integration (M&I) contracts. Most DOE work is contracted to universities and corporations, utilizing small businesses as appropriate. However, DOE also has numerous Fixed-Price and other contract types in place, all dependent on the project or contract level of definition. A majority of DOE projects are managed as a part of M&O or M&I contracts, normally utilizing many sub-contracts.

All of these contracts have some aspect of performance tied to them. The projects with more definitive scopes of work are easiest to quantify and to measure in output, or performance objectives. Each contracted activity should be carefully analyzed for size, complexity (including safety / security components), and its most appropriate or effective contract type.

<b>Table 4-4 Contract Types</b>	
<b>Type of Contract</b>	<b>Elements</b>
Fixed-Price or Lump Sum	Includes material, labor, equipment, subcontracts, indirect costs, overhead, profit, contingency, and escalation
Cost-Plus Fixed Fee	Includes reimbursement for material, labor, equipment, subcontracts, indirect costs, overhead, and escalation. Fee is NOT determined by performance - it is fixed. Contingency is used for planning as necessary.

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Cost-Plus Award Fee	Includes reimbursement for material, labor, equipment, subcontracts, indirect costs, overhead, and escalation. Fee is determined by performance, but is most subjective of the Cost-Plus contract types. Contingency is used for planning as necessary.
Cost-Plus Incentive Fee	Includes reimbursement for material, labor, equipment, subcontracts, indirect costs, overhead, and escalation. Fee is determined by performance, but most objective of the Cost-Plus contract types. Contingency is used for planning as necessary.
Labor Hour Contracts	Material, labor, equipment, subcontracts, indirect costs, overhead, profit, and escalation are rolled into hourly labor rate. Contingency may be planned otherwise (i.e. quantities, etc.).
Unit Cost Contracts	Material, labor, equipment, subcontracts, indirect costs, overhead, profit, and escalation are rolled into costs per unit. Contingency may be planned otherwise (i.e. quantities, etc.).
Task-Order Contracts	Similar to Labor Hour contracts, except oriented to specific tasks.

### **Key Point**

Design-Build contracts may be managed as a Fixed-Price or Cost-Reimbursable contract (or sub-contract), and should be:

- Commensurate with the projects size and complexity
- Appropriate for the projects situation
- Consistent with the projects acquisition strategy

### Cost Estimate Content Organization

Specific definition of items to be included as direct costs, indirect costs, and overhead costs should be at the discretion of the DOE program offices and DOE field offices and/or determined by their contractors financial system, however the following is provided as guidance. The point of defining these here is to assure that there is no accounting overlap between items estimated as direct, indirect, or overhead costs. Generally, cost estimate content should include:

- Direct costs
- Indirect costs, including overhead and profit
- Contingency
- Escalation



### **Key Point**

Each activity in a project must be considered *either* a direct or an indirect cost; however, there should be no duplication or overlap. There should be a clear distinction between those activities that are directly or indirectly related to a project. Regardless of this distinction, a cost can be considered either direct or indirect; dependent upon the situation, site, program, or project-specific requirements or procedures, one direct cost at one site, or project, may not be the same for another. Generally, this distinction should be consistently applied among projects, for a DOE program, or at a DOE site location.

ONE OR THE OTHER, BUT NOT BOTH.

### **4.5.1 Direct Costs**

*Direct costs* include any costs that can be attributed to a particular project or activity, including labor, materials, subcontracts, equipment, salaries, and travel. Emphasis is placed on the term *activity*, which typically in standard practice equates to a lowest WBS element or COA.

Items typically recognized as **direct costs** include, but are *not limited to*:

- Construction activities, including labor, materials, equipment, subcontract costs, premium pay, contamination restrictions, labor / equipment, and productivity adjustments
- Operations activities (operations-type cost estimates), including labor, bulk materials, operating equipment, and fuel
- Decontamination, decommissioning, dismantling, and demolition activities
- Project management
- Design / development and start-up activities
- Security escorts and restrictions
- Special (capital) and standard (capital, non-capital) equipment
- Freight, packaging, and transportation
- Health, physics support, radiological controls support, protective clothing / PPE, and industrial safety / health

Items which may be considered as direct costs as a part of the **labor rate** (fringes benefits or labor burden) include:

- Holiday and vacation pay
- Payroll taxes and insurance
- Contract fee / profit (may be included in overheads or loaded-labor rates)

Items may be included as direct or indirect costs, commensurate with the technical scope and local accounting practice, as appropriate.

### **4.5.2 Indirect Costs**

Indirect costs are incurred by an organization for common or joint objectives, that which cannot be specifically identified with a particular activity or project. Depending on the contract types and circumstances, these may also include: programmatic functional costs, such as comprehensive planning, security, procurement, engineering, project controls, cost and schedule estimating, or

## **DOE Cost and Schedule Estimating Guide – DRAFT February 2003**

research and development. These indirect costs may also include a contracts General and Administrative costs, or G&A.

Profit, or fee, may be included in a site indirect rate, depending on contract type, financial system, or circumstance. Fee is normally associated with Cost-Plus contracts, where fee is determined based on some pre-established performance objective, or an assessment of certain criteria (i.e. Cost-Plus-Incentive-Fee). Profit is normally associated with a Fixed-Price contract, wherein profit is the unknown until all costs have been incurred. Profit is sometimes known as the 'wages of risk'. Both fee and profit should be considered commensurate with risks involved.

Items typically included as indirect or overhead costs are:

- Administration, Accounting, Procurement, and Legal
- Personnel, office supplies, and expenses, and time reporting
- Construction engineering (contractor), facilities, equipment and general maintenance
- Laundry, water, compressed air, small tools, welding tests and power (temporary may be indirect costs, general for operations may be included as overhead)
- Motor pool, camp, and aircraft operations
- Permits and licenses
- Safety, medical, and first aid
- Sales tax, contributions to Welfare plans, signup / termination pay
- Contract fee / profit, bonds (performance and material payment)
- Security
- Warehousing, transfer, and relocation

### **4.5.3 Allowances, Contingency, and Management Reserve**

The purpose of contingency guidance is to provide a standard for calculating, documenting, and improving the understanding of contingency in the project management process.

The application of contingency for various types of cost estimates covers the entire life cycle of a project, from feasibility through execution, operations, and

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

ultimate disposition. Generally, as the design of a project develops, progresses to construction, and nears completion, the need for contingency decreases.

The concepts of contingency may be generically applied to the technical, cost, and schedule aspects of any project. This may also similarly apply to schedule contingency (see Chapter 5). The point of including MR and contingency is to assure a successful project completion.

### Funding Type

Contingency should also be appropriate for a project, regardless of funding type. Capital funding typically includes the traditional construction-type projects. Calculation of MR and contingency for these is the most widely-used, systematic, and standardized of all project types. Reporting contingency for these projects in budget requests is also considered routine.

For expense-funded projects (non-traditional, operations-type), contingency is not as commonly included. However, if a project has technical risks (risks that could pose a threat to successful project completion), those cost and schedule aspects should be included, and managed properly. Since expense-funded projects historically have not had the rigor of planning, budgeting, and managing contingency, discretion lies within the DOE program or field office. However, if there is *any* risk or uncertainty – technical, cost, or schedule – there should be related contingency associated with it to provide for successful project completion. A Risk Analysis and Contingency Analysis should be provided to explain the project risks and calculated contingency, with a summary included.

For other funding, or non-traditional projects, such as privatization projects or Design-Build-Operate-D&D projects, contingency should be carefully considered and included appropriately. A Risk Analysis and Contingency Analysis should be provided to explain the project risks and calculated contingency, with a summary included.

Examples of the calculation and use of contingency may be found in Chapter 8.



Allowances, management reserve, and contingency should be considered normal elements of a project.

Allowances should be tied to undefined scope.

Management reserve (MR, or contractor-held contingency) should be commensurate with project risks.

Contingency and MR should be included, commensurate with project risks and uncertainty, primarily to assure the successful project completion.

#### **4.5.3.1 Allowances**

In planning projects, it is normal to include activities for which there is little or no design basis, especially in the earliest stages of a project. These activities may be included as allowances. These are *not* considered a contingency. Allowances should be included as appropriate, at the discretion of the program or project, to cover anticipated costs associated with a known technical requirement or activity. For instance, in a Type 5 cost estimate (earliest project planning stages), it would be appropriate to see a line item (cost account, or activity) such as "Utility relocation, 1 lot, \$1M material and \$1M labor". There should be other documentation supporting these costs, proportioned to the importance of the activity. Allowances may also be included in a project to cover costs associated with productivity adjustments, subcontract changes (anticipatory basis), design changes (anticipatory basis), or other similar elements of known scope and costs.

#### **4.5.3.2 Management Reserve (MR) and Contingency**

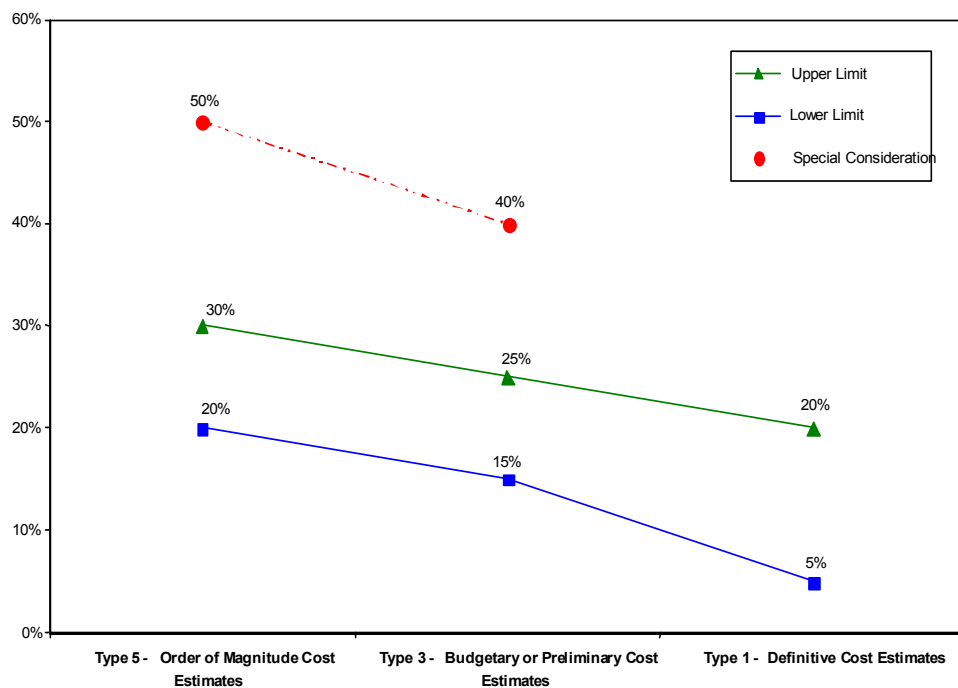
Management reserve (MR, contractor contingency) and contingency (DOE-held contingency) are an integral part of project TPC or APB. The amount of MR and contingency should be commensurate with the status of design, procurement, construction, or operation: project / program size, complexity, contract type, schedule, market conditions, project-specific special considerations, project risks, and any other technical uncertainties of the component parts of the project. Management reserve and contingency may, and usually should, be included as

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

separate Control Accounts in cost estimates. Figure 4-6 depicts the contingency as a function of project life.

Although contingency and its use should be tightly controlled, DOE field offices should consider the use of a MR by its contractors to either offset normally encountered changes. The purpose of MR and contingency is to absorb expected changes that occur in normal project development and execution. In some cases, it may be appropriate for a program or project to consider use of a contractor's negative variance as management reserve. Contingency and MR are expected to be expended as necessary to maintain project TPC (APB); however, if variance exceeds thresholds and cannot be corrected using all available contingency and MR, a breach occurs (discussed in Section 7.8).

Figure 4-5 Contingency as a Function of Project Life-Cycle



Contingency may be calculated either of two ways – a *Deterministic* or a *Probabilistic* Approach. Either method may be employed; however, the entire point of contingency is to manage, or mitigate, project risks:

- *Deterministic Approach* - where percentages are selected based upon the degree of risks and uncertainty for several common types of projects and situations, usually from a table, and performed normally during the early stages of project development.

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

- *Probabilistic Approach* - uses statistical simulation (i.e. Monte Carlo simulation, range estimating, etc.) and generic steps into calculating appropriate amounts of contingency, normally during the later stages of project development, as more definitive information is available.

### Deterministic Approach

Unforeseen, uncertain, and unpredictable conditions will exist. Some considerations which affect the selection within those ranges may be:

- State-of-the-art design
- Required reliability
- Equipment complexity
- Construction restraints due to continuity of operation
- Security
- Contamination, environmental conditions (weather, terrain, location)
- Scheduling
- Other items unique to the project such as nuclear and waste management permits and reviews

The Deterministic Approach to calculating contingency is simply an approximation, based on complexity, degree of scope definition, or some other pre-defined parameter. The cost estimate *type* is a primary determining factor. Parts of the estimate may have different degrees of design completion, and an appropriate contingency percentage may be used from Table 4-5.

**Table 4-6 Contingency Allowance Guide By Type of Estimate**

Type of Estimate	Overall Contingency Allowances % of Remaining Costs Not Incurred
Type 5 - Order of Magnitude cost estimates	20% to 30% (Special Consideration Up to 50%)
Type 3 – Budgetary or preliminary cost estimate	15% to 25% (Special Consideration Up to 40%)

**Table 4-6 Contingency Allowance Guide By Type of Estimate**

Type of Estimate	Overall Contingency Allowances % of Remaining Costs Not Incurred
Type 1 – Definitive cost estimates	5% to 20%

#### Probabilistic Approach

A Probabilistic Approach may be used in calculating contingency. This approach is normally more appropriate for larger, more complex projects. In using a Probabilistic Approach, you must first understand the statistical concept of probability. Probability is the degree of certainty or likelihood of something to happen. Probability is normally expressed as a percentage, where a 99% probability means that something will be very likely to occur.

Generic steps using the Probabilistic Approach to calculating contingency:

- Identify items whose risks could impact successful completion (i.e. technical completion within schedule and budget). Summarize to a level at which contingency will be managed.
- Assign probabilities, risk curves, and best / expected / worst-case scenarios, as applicable
- Calculate contingency to cover risks



#### **Key Point**

There are various ways to identify risks, establish probabilities, and calculate contingency (including the use of various software).

Policy regarding the calculation and management of contingency should be established within a program or field office for consistency and standardization. However, there is no DOE policy regarding percentages to be used, or specific confidence levels to be obtained, in order to manage successful projects.

### Programmatic Risks

It is not DOE practice to set aside contingency for major schedule changes or unknown design factors, unanticipated regulatory standards or changes, additions to project scope definition, force majeure situations, or Congressional budget cuts. These are programmatic risks, which are applicable to all projects within their respective programs. Programmatic risks should be addressed consistently among projects, but should generally not be included as contingency to offset a worst-case-scenario. This is the prerogative of the responsible DOE program office.

### Buried Contingency

Typically, it is not sound business or professional practice to overstate anticipated costs. Although excess estimates of costs should always be avoided, it is better to have a sound basis for costs that are included than to bury contingency. All estimators should refrain from burying contingency or un-necessary allowances within an estimate. A culture of honesty should be promoted so that it is not necessary to bury contingency. Estimators should be aware that reviews may identify buried contingency; known buried contingency should be removed.

### Contingency Analysis / Risk Analysis

A Contingency Analysis is a written explanation of how contingency was calculated, along with a summary of the contingency costs that are calculated. Considerable latitude has been reserved for estimators and managers in performing Contingency Analysis. However, a written contingency analysis should be performed on all cost estimates and maintained in the estimate documentation file.

Justification must be documented in writing when guide ranges for contingency are not followed. If extraordinary conditions exist that call for higher contingencies, the rationale and basis should be documented. Computer programs may be used to develop contingency factors. Risk Analysis should be used to support the Contingency Analysis.



#### **Key Point**

As a project progresses, and subsequent cost estimates are performed, contingency ranges and amounts should decrease.

### **4.5.4 Escalation**

Costs continuously change due to three factors: 1) changing technology, 2) changing availability of materials and labor, and 3) changing value of the monetary unit (i.e. inflation). Historical cost indices and forecasted escalation indices have been developed to document and forecast changing costs. The use of escalation is required to forecast future project costs. The use of an established index is a quick way to consistently calculate costs. To ensure proper usage of an index, one must understand its bases and method of development.

Escalation is the provision in a cost estimate for increases in the cost of equipment, material, labor, etc., due to continuing price changes over time. Escalation may be 1) forecasted - to estimate the future cost of a project, based on current year costs, or 2) historical - to convert a known historical costs to the present. Most cost estimating is done in current dollars and then escalated to the time when the project will be completed, although the forecasted and historical escalation rates may be used in succession. This section discusses the use and application (calculation) of escalation and historical cost indices. An example of the calculation and use of escalation can be found in Chapter 8.

#### **Forecast Escalation**

Forecast escalation rates are obtained from commercial forecasting services, such as Global Insight (formerly DRI-WEFA), which supplies its most current predictions using an econometric model of the United States economy. The forecasted escalation index is the ratio of the future value to the current value expressed as a decimal. Forecast escalation rates are simply the percentage change from one year to the next. Forecast escalation indices are typically prepared for various groups, utilizing different sources of data. For example, the forecast escalation indices for construction may be different from the one for environmental restoration, primarily because the "market-basket" of goods is so varied. Annual escalation rates are recommended by OECM through the annual Budget Formulation Guidance, to the DOE program offices and DOE field offices.

Since the duration of larger projects extends over several years, it is necessary to have a method of predicting the funds that must be made available in the future to pay for the work. This is where forecasted escalation indices are used. The current year cost estimate is, if necessary, divided into components grouped to match the available forecast escalation indices. Each group of components is then multiplied by the appropriate predictive escalation index to produce an estimate of the future cost of the project. The future costs of these components are

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

then summed to give the total cost of the project.

To properly apply escalation indices for a particular project, the following data is required:

- Reference date the estimate was prepared and base date of costs
- Escalation index (including issue date and index) used to prepare the estimate
- Schedule, with start and completion dates of scheduled activities

Escalation should be applied for the period from the date the estimate was prepared to the midpoint of the performance schedule, or the activity being escalated.

### **Key Point**

Several different methods may be used to calculate escalation, including the use of a specific project spending curve.

Escalation should be included at a level appropriate for the size and complexity of the project.

### Historical Escalation

Historical escalation is generally easily evaluated. For example, the cost of concrete differed in 1981 versus 2002. The ratio of the two costs expressed as a percentage is the escalation rate, or expressed as a decimal number is the historical cost index. Several commercially available Historical Cost Indices are available.

To properly apply a historical cost index to make price more current, the following data is required:

- The prior cost or price, with a reference date, like an actual price for a known project, or a component: may include material and/or

## **DOE Cost and Schedule Estimating Guide – DRAFT February 2003**

labor cost, and should be known to what extent indirect costs, overheads, and profit impacted

- An applicable historical cost index

### Developing Escalation Indices

An escalation index may be developed for a particular group of projects (usually geographic or programmatic). Projects are divided into elements, which can be related to current industry indices. The elements are then weighted and a composite index is developed. Complete details on developing escalation indices can be found in the MA-0063, DOE Cost Guide, Volume 5, How to Construct and Use Economic Escalation Indices (circa 1982).

Cost indices have limitations, since they are based on average data. Judgment is required to decide if an index applies to a specific cost being updated. If using an index for a long-term project, remember that the long-term accuracy for indices are limited. However, these rates can only be beneficial if there is consistent use among DOE programs and projects.

More specific guidance regarding the use and application of escalation may be provided by the DOE program or field office.

### **4.5.5 - Other Project Costs (OPC's)**

Any activities that are not representative of total estimated cost activities are allocated to other project costs, or OPC. They are typically preliminary design activities, startup costs, and limited support functions.

OPC's include all other costs related to a project that are not included in the TEC. OPC's are also discussed in Section 7.7 - TEC/OPC/TPC (APB), and Table 9.7 should be used as guidance in classifying and determining TEC/OPC activities.

## **Section 4.6 – Cost Estimate Ranges**

DOE Order 413.3 requires the use of ranges to express project cost estimates and schedules. These ranges depict the projects TPC in the early stages of the project, i.e. at CD-0 and CD-1, normally before the commitment to an APB, at CD-2. Ranges should be shown in dollars and time, cost and schedule.

## **DOE Cost and Schedule Estimating Guide – DRAFT February 2003**

These ranges may be determined or based upon various:

- 1) Project alternatives
- 2) Projected risks
- 3) Confidence levels (successful completion)

## **Chapter 5 - SCHEDULING**

Section 5.1 - Schedule Requirements

Section 5.2 - Schedule Types

Section 5.3 - Schedule Presentation

Section 5.4 - Schedule Elements

Section 5.5 - Schedule Contingency

Section 5.6 - Schedule Process

Section 5.7 - Schedule Baseline

Section 5.8 - Schedule Performance

Section 5.9 - Schedule Reviews

### **Section 5.1 - Schedule Requirements**

DOE cost and schedule estimate requirements are derived from Federal requirements, DOE requirements (DOE Orders), and industry standards outlined in Chapter 3. These requirements include schedules developed to support:

- 1 - CD Process within Programs/Projects (DOE O 430.1 and DOE O 413.3)
- 2 - Annual Budget Process (DOE O 130.1 Budget Formulation)
- 3 - Contract Actions (DOE O 542.1 Competition in Contracting)
- 4 - Other project / program management decisions (various Federal regulations, DOE Orders, and industry practices). This includes the development of LCA, in particular for VE analyses, and to support Change Control.

Also, DOE Order 413.3 references the use of ANSI EIA-748 for the calculation and use of earned value (EV). This standard also sets requirements for scheduling by establishing formality and consistency. It requires that scheduling systems contain summary and master schedules with contractually specified milestones. Summary schedules should be clearly linked to lower level schedules and detailed task schedules. All cost accounts and work packages must contain specific start and completion dates based on physical accomplishment. Schedules must be integrated to higher / lower levels, and between time periods.

### **Section 5.2 - Schedule Types**

#### **Project Master Schedule**

A project master schedule is an upper-, or summary-level schedule which identifies the major components of a project, and usually identifies major milestones.

#### **Project Milestone or Summary Schedule**

A project milestone or summary schedule is comprised of the key events that are generally critical accomplishments, planned at specific time intervals throughout a project, used as a basis to monitor overall project performance.

#### **Detailed Schedule**

A detailed schedule is used to communicate the day-to-day activities to the working levels of a project.

#### **Other Schedule Types**

Baseline schedule - set of approved milestones and activities used to measure schedule performance.

Current working schedule - reflects current activity and status.

Cost profile - depicts costs, over time.

Funding profile - depicts costs, over time, with a lead for obligating those costs; also known as a funding S-Curve.

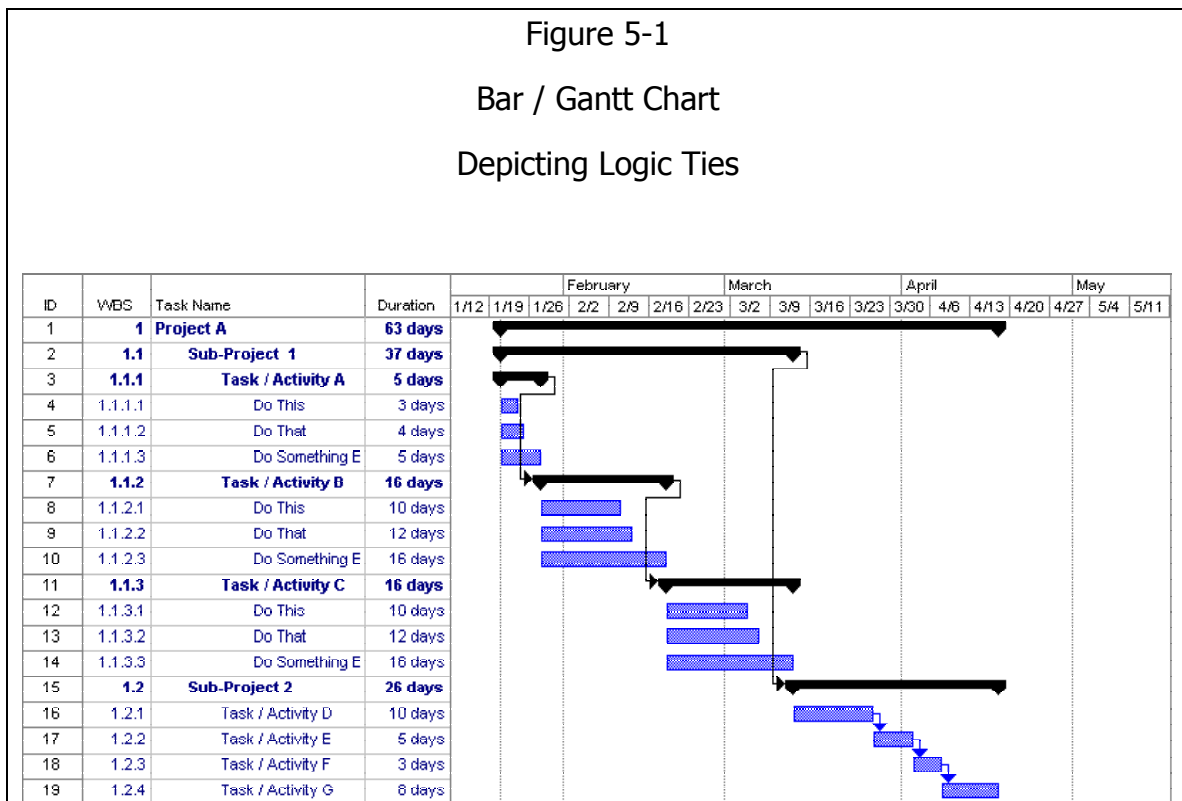
### **Section 5.3 - Schedule Presentation**

A schedule is a display of project time allocation, for the execution of a project. Schedules consist of activities with start dates, milestones, and end dates, linked with planned constraints, available resources, and logic ties. Similar to cost estimates, schedules have common attributes that depend on where a project stands in its life-cycle, the available information, the methods used to establish durations, and time constraints.

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

### Bar/Gantt Chart

A bar chart graphically represents the different work activities involved in a project and their time relevance. Activities, or summaries of groups of activities, are usually represented by a time-related bar. Logic, or interdependency, may be shown on a bar chart schedule. Bar / Gantt charts are typically used for high level or status briefings. An example of a Bar / Gantt chart is illustrated in Figure 5-1.



### Milestone or Event Charts

Milestone and event charts, or tables, are typically used for high level briefings. These may be tabular, or shown as a schedule with milestone indications at the required dates.

### Network (Logic) Diagrams

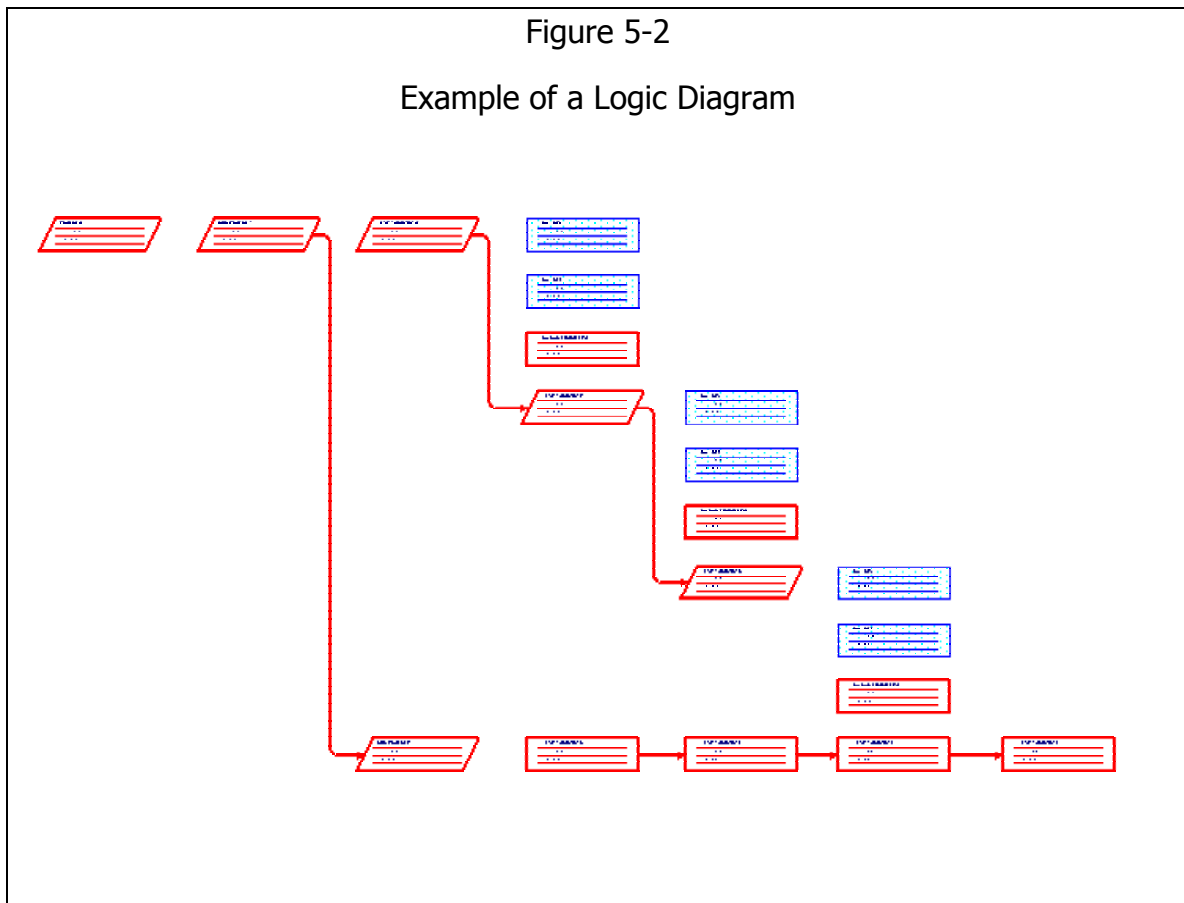
Similar to a bar chart, a network diagram graphically represents work activities. The difference is that the network diagram depicts the activities and their independence / interdependence. Typically, a network diagram

contains activities, durations, interdependence, and a calculated critical path. Network diagrams are the most common form of scheduling tool. These schedules are normally generated by computer and represent logic needed to manage a project.

Most computer-aided scheduling tools also contain information regarding resources, responsibility, and other pertinent data. As a project management tool, these may also provide information regarding status and EV.

Figure 5-2

Example of a Logic Diagram



### **Section 5.4 - Schedule Elements**

Elements included in any schedule should be commensurate with the project planning and design development. Typically, a schedule should be organized around a project WBS and should be directly related to a cost estimate and a scope of work.

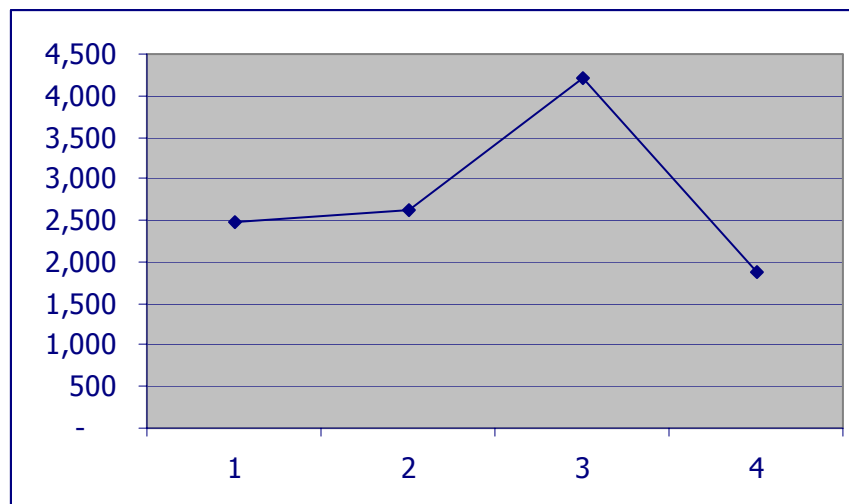
## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

The schedule is one of the building blocks for project development. It helps to determine the duration of the project, the critical activities, and points when funds will be required. A schedule always has an associated cost estimate. The basic elements comprising the schedule consist of the activities in the project (lowest level of WBS), the duration of each activity, the sequence in which those activities occur, and the resources required.

Figure 5-3

### Funding Profile and S-Curve

			FY Funding				
	Activity	TPC	03	04	05	06	07
A1A	Preliminary Design	103	103				
A1B	Definitive Design	207	207				
A1C	Design during Construction	109		37	37	36	
B2A	Equipment Procurement (General Services)	220			110	110	
B2B	Equipment Procurement (Long-Lead, GFE)	2,623	2000	623			
B2C	Facility Construction	6,597		1500	3597	1500	
C1A	Project Management	534	75	175	175	109	
C1B	Construction Management	267	25	100	100	42	
C1C	Project Support	267	25	100	100	42	
D	Management Reserve	180	25	75	75	5	
E	Contingency (DOE-Held)	86	10	25	25	26	
	Total Project Costs (Escalated)	11,193	2,470	2,635	4,219	1,870	-



## **DOE Cost and Schedule Estimating Guide – DRAFT February 2003**

The activities, or tasks, from a WBS are the building blocks for a schedule. An activity is any specific element of work. It is important that activities not be confused with schedule events. Events are indicators of the beginning or completion of an activity. An event milestone is usually one specific point in time, whereas an activity occurs over a period of time.

The activity duration is simply the time required to complete the work involved in a specific activity. The sequence of activities refers to the order in which the activities are scheduled to be performed. The duration of the project is the longest series or path of interdependent activities in the schedule. The critical path of a project may change from time to time as activities are completed ahead of, or behind, schedule.

Control Accounts (Code of Accounts) are used to define elements to be worked, or controlled. A Control Account may be directly related to a WBS element or simply an activity. Normally, for performance measurement, there should be a quantity related to the Control Accounts. Control Accounts are to be managed discreetly and are the lowest levels in reporting EV.

### **Section 5.5 - Schedule Contingency**

Schedules, similar to cost estimates, should plan for successful completion. In most cases, this requires the use of schedule contingency. Contingency is a broad term to be used in consideration of encountered risks, contract types, project constraints, etc. to mitigate the cost and schedule associated with those risks. Schedule contingency is an amount of time identified with a project's schedule to compensate for potential occurrences of schedule risk factors. Refer to Section 4.5.5 and examples in Chapter 8 regarding the calculation and use of contingency.

Similar to cost estimates, schedules should include allowances, MR (contractor-held contingency), and contingency (DOE-held contingency) for time and resources. The entire purpose of MR and contingency is to absorb changes during the normal development and execution of a project. Contingency and MR are expected to be expended as necessary to maintain the project TPC (APB); however, if variance exceeds thresholds and are not able to be corrected using all available Contingency and MR, a breach results, which is discussed in Section 7.7.

Methods of establishing appropriate amounts of allowances, MR, and contingency are less-well defined for schedules than for cost estimates, although there are similarities. Using a Deterministic Approach versus a Probabilistic Approach, takes on a different connotation for establishing schedule contingency. When available, resource-loading and optimization may be necessary prior to

establishing a schedule contingency. Also, similar to cost contingency, schedule contingency should be based on risks, and provide for a high degree of confidence in successful completion.

The following steps should be taken to develop schedule contingency:

- 1 - Identify risks
- 2 - Quantify risks
- 3 - Identify actions to mitigate risks
- 4 - Calculate time necessary to mitigate risks
- 5 - Set milestones to mitigate risks
- 6 - Assign management responsibility to manage schedule contingency

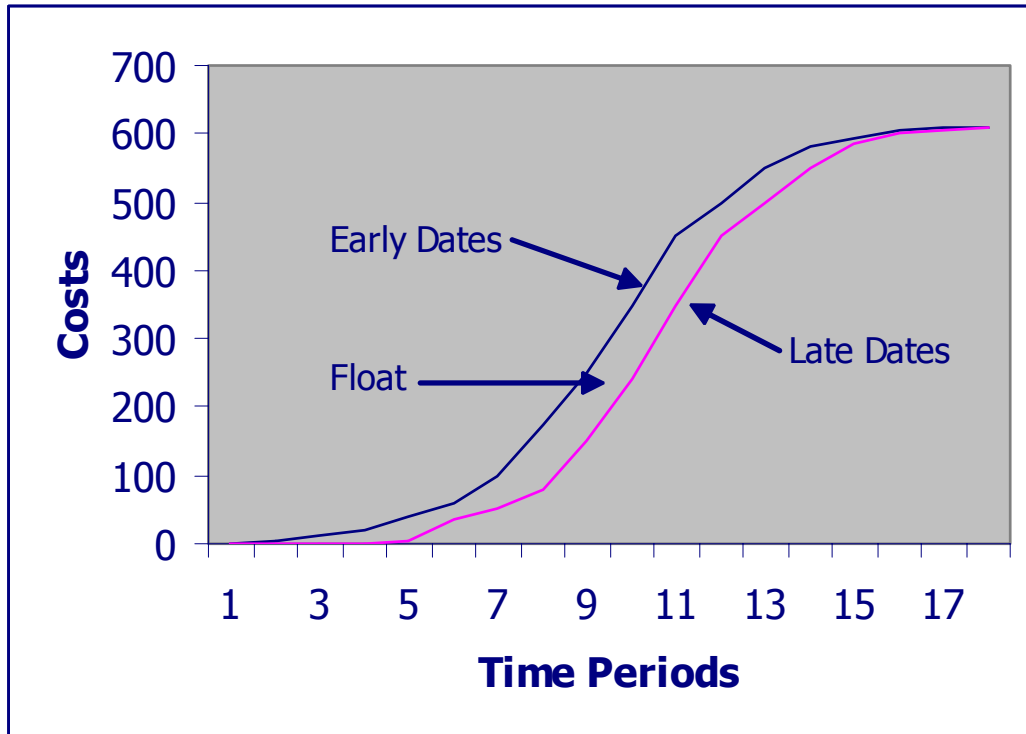
### **Section 5.6 - Schedule Process**

Schedules are developed by planning tasks and work packages, within a designated scope of work. For management purposes, the project should be organized and planned around a WBS.

Steps in establishing a project schedule:

- 1 - Define the project scope and WBS
- 2 - Identify milestones
- 3 - Develop the master schedule
- 4 - Develop detailed task schedules (activities / work package)
- 5 - Assign responsibilities and resource requirements
- 6 - Develop network logic, durations, and lead times to determine start / complete dates. Calculate Critical Path.
- 7 - Reconcile the detailed task schedules and resource requirements to the master schedule.

Figure 5-4  
Schedule Envelope



### Key Point

Be cautious of using constraint dates.

## **Section 5.7 - Schedule Baseline**

From project inception, a schedule should be used to plan and execute near-term work. As a project develops through design and planning stages, the project team should focus on establishing a baseline in order to measure overall project

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

performance. The Acquisition Performance Baseline (APB) established at CD-2 includes schedule parameters that are used to measure project performance.

### Activities

Typical activities to be included typically include those to support: Critical Decisions, program milestones, design, construction, project management, budgeting, and procurement.



#### **Key Point**

Project schedules should include separate activities for procurement of long lead materials and equipment. Example activities include submittals, approvals, procurement, fabrication, delivery, and installation.

### **Section 5.8 - Schedule Performance**

The CPM must depict the latest status to be meaningful and be should be compared against approved baseline.

Three schedule files should be maintained:

S1 – The baseline CPM, used to monitor project performance

S2 – The CPM for prior reporting period, also used to establish trends and document historical information

S3 – The CPM for current reporting period, also used in trend identification and establishing project performance, or EV

Earned value should be regularly, systematically calculated and reported. The baseline schedule represents the Budgeted Cost of Work Schedule (BCWS, or planned value , or PV). The actual costs and time incurred represent the Actual

## **DOE Cost and Schedule Estimating Guide – DRAFT February 2003**

Cost of Work Performed (ACWP, or actual costs, AC). The EV depicts the value of the work performed, the Budget Cost of Work Performed (BCWP, or EV).

### **Section 5.9 - Schedule Reviews**

A comprehensive schedule should address or identify:

- The Project WBS, including the scope of work and the cost estimate
- Activities on the Critical Path, with reasonable durations
- Milestones
- Resources and responsibilities
- Risk factors, including mitigation strategies
- Assumptions, including constraints
- A funding profile, showing the cost and obligations (funding) requirements by year in both constant year and escalated dollars
- Interfaces between projects or various resources

Schedules should also be at an appropriate level of detail and in the form of a bar chart or logic diagram (using Critical Path Method), commensurate with the projects development.

Schedules can play an important role in the cost estimate since it can help to identify the basis for budget-cycle timing, to ensure timely delivery premiums on long-lead items, or to serve as a basis for escalation. The schedule may also be used to identify critical activities and durations in order to accomplish milestones within the project. The schedule used or developed with the cost estimate should be documented, and is considered part of the cost estimation package.

The cost and schedule estimating process should be systematic so that an independent third party reviewer could reproduce a cost estimate from a given scope of work, a schedule, and a basis of estimate, without indication of proposed / anticipated costs.

## **Chapter 6 - REVIEWS**

Section 6.1 - Internal Reviews

Section 6.2 - External Reviews

Section 6.3 - Cost Estimate Quality Objectives, Criteria, and Measures

Section 6.4 - Historical Cost Data

Section 6.5 - Lessons Learned

### **Section 6.1 - Internal Reviews**

One of the recent issues regarding cost estimating is the apparent lack of documentation and credibility supporting DOE projects and programs. This section should provide assurance that documentation is present and that cost estimates are credible. By establishing minimum criteria by which cost estimates should be judged, both internally for program and field office, and externally for independent verification, validation, or review, this can be accomplished.

Cost estimate reviews, both internal and external, are discussed in Sections 4.4.3 and 4.4.4 as part of the cost estimating process. An objective approach to cost estimate quality will result in a measure of performance. This performance may be tracked to assure cost estimate quality improvement and reliability.

The third step in the cost estimating process, internal reviews, includes reviewing the cost estimate for quality aspects, prior to its final intended use. These internal reviews are the first line of quality assurance, and acts as a mechanism of establishing consistency and standardization, and should be systematically applied. Internal reviews are primarily performed by DOE program field office, and contractor cost estimators, project managers, and program managers.

Internal reviews should be internal to a program office, field office, or a contractor with fiscal responsibility, as delegated by a program office or field office, but may include input from independent third-party reviewers. These reviews may be objective and / or subjective in nature, and as a minimum, should consider the criteria listed below. These criteria are explained in full detail in Appendix 9.2.

1. Escalation
2. Contingency
3. Indirect and overhead rates

## **DOE Cost and Schedule Estimating Guide – DRAFT February 2003**

4. Qualified cost estimators
5. Work Breakdown Structure (WBS)
6. Scope of work (SOW)
7. Level of Effort (LOE)
8. Methods
9. Cost estimate documentation
10. Cost estimate updates
11. Life-Cycle costs

The use of the cost estimate review criteria, used consistently, should enhance the systematic process of developing and documenting credible cost estimates. To the extent possible, these reviews should make a conclusion of "reasonableness," which is necessary for contract actions and budget submissions. A comprehensive checklist for reviewing project cost estimates is included in Appendix 9.3.

### **Section 6.2 - External Reviews**

The last step in the cost estimating process is the external review. This step includes reviews conducted outside the cognizance of the party responsible for the cost estimate. This is also a quality check, but may be done to answer questions from interests outside the responsible DOE program, such as Congress, Offices of the Inspector General, the General Accounting Office (GAO), and others. Normally, independent, third-party reviewers provide these reviews. Some of these reviews are systematic, such as External Independent Reviews (EIR's) that are mandated by Congress. Others are ad hoc, and are brought about by real or perceived poor project performance or other management issues.

At a minimum, a reviewing party should be provided with any established procedures, policies, and practices used by the organization responsible for the project's cost estimate. This would include information regarding preparation of the cost estimate, and the criteria used for internal review.



### Key Point

In many cases, cost estimate information supporting the project subject to an external review will have no chance of near-term correction, and will stand in support of the project viability and chance of successful completion.

### **Section 6.3 - Estimate Quality Objectives, Criteria, and Measures**

Cost estimate accuracy cannot typically be measured before the completion of a project. There are ways to project accuracy to similar projects, or other historical points of reference, or by comparison analysis with other estimates for the same work. These methods, although widely used, can contain unseen flaws. Care must be taken when using these methods to assess cost estimate accuracy.

Cost estimate quality may be measured at almost any point within the life of a project. A consistent measure of project cost estimate quality, at various points within its life-cycle, can serve to ensure accuracy, completeness, and credibility. This measurement can also serve as a basis for performance measurement. Contract performance objectives may be established around cost estimate reviews and periodically used as a measure of performance in the area of cost estimating. There are many different criteria for use in reviewing cost and schedule estimates, including the DOE Budget Formulation Guidance for budget validation.

Criteria for measuring performance may be negotiated, but should focus on the minimum eleven criteria (see Appendix 9.2). For example: 100% of cost estimates performed (by an organization, for a given purpose, etc.) should include appropriate escalation rates, contingency, indirect and overhead rates, etc. These criteria, if measured consistently over time, should provide information regarding the cost estimate *quality*. As projects are completed, it becomes relatively to cost estimate accuracy.

### **Section 6.4 - Historical Cost Data and Lessons Learned**

\*The Project Closeout Report can be found in Chapter 10 – References.

Systematic collection and maintenance of useful historical cost data is the epitome of sound project closeout and lessons learned. However, useful historical cost data in the DOE has been an elusive principle. Across the DOE complex, individual project teams and project cost estimators have compiled

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

useful historical cost information. But this information should be made more available and useful complex-wide. This data will be extremely beneficial for all DOE projects and programs, for several reasons: consistency and standardization, reliability / credibility, and fulfilling a need for easier verification / validation. This data must be in some standard organization to be useful.

DOE projects and programs are encouraged to use a systematic approach in establishing cost and schedule estimates, from inception through the life-cycle. Cost and schedule data should be maintained (analyzed / normalized), collected, and stored for future use. In this approach, it is highly recommended that a consistent WBS and a standardized COA be used. Examples of standardized COAs are available in Appendices 9.4, 9.5, and 9.6.



Considering projects after they are completed, and back-fitting historical cost information into categories, although useful, is not the best approach. This has been attempted on numerous occasions, with limited success, but is not widely recognized, recommended, or used.

Maintaining Lessons Learned from completed projects is a form of historical information, but is more relative to complete projects, not cost aspects. Lessons Learned considers where the project started (including methods used in estimating early phases), where the project progressed (various changes throughout the life-cycle), and where the project finished (final costs and technical aspects). This type of data may be useful in getting a project through difficulties in estimating in the life-cycle.

## **Chapter 7 - OTHER RELATED TOPICS**

Section 7.1 - Value Engineering

Section 7.2 - Work Breakdown Structure (WBS) and Code of Accounts (COA)

Section 7.3 - Cost and Schedule Estimating Tools

Section 7.4 - Life-Cycle Costing (LCC)

Section 7.5 - Activity-Based Costing (ABC)

Section 7.6 - TEC / OPC / TPC (APB)

Section 7.7 - Breaches

Section 7.8 - Earned Value

### **Section 7.1 - Value Engineering**

Value engineering (VE) in the DOE is a requirement. Each year DOE provides OMB with a report of costs-saved as a result of VE studies. DOE has established DOE Notice 413.2 as policy for VE. The purpose of the Notice is to establish DOE VE policy that meets the requirements of Public Law 104-106, Section 4306 as codified by 41 United States Code 432. This law states that each agency shall establish and maintain cost-effective VE procedures and processes. Additionally, OMB Circular A-131, Value Engineering, requires all Federal agencies to use VE as a management tool, where appropriate, and to use a graded approach; a graded approach will ensure realistic budgets, identify and remove nonessential capital / operating costs, and improve / maintain optimum quality of program and acquisition functions.

The DOE requirement is to establish and maintain a VE program that meets the intent and criteria set forth in Public Law 104-106 and OMB Circular A-131 for all Departmental elements. To meet this requirement, the Under Secretary for Energy, Science and Environment, and the Administrator of the National Nuclear Security Administration will:

- Designate a senior management official who has responsibility to establish, coordinate, maintain, and document a viable VE program for programs and projects under cognizance

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

- Develop criteria and guidelines for both in-house personnel and contractors to identify programs/projects with the most potential to yield savings from the application of VE techniques
- Develop annual plans for using VE to include setting performance goals, and to report annually on actual performance compared to those goals
- Ensure that funds necessary for conducting VE efforts are included in annual budget requests

The VE or value management process is well-documented and defined as an industry standard. Each VE study, as a regimented analysis of alternatives, requires cost and schedule estimates and LCCA for certain aspects of a project under consideration, and in most cases, for the entire projects life-cycle. More information on conducting LCCA may be found in examples in Chapter 8.3.

### **Section 7.2 – Work Breakdown Structure (WBS) and Code of Accounts (COA)**

This section will discuss the purpose of the WBS and COA cost code system. A cost estimate is developed primarily for establishing the project budget and for providing the appropriate documentation and justification for a funding request. Once a project is funded, this cost estimate is not filed away. It becomes the baseline or target against which the project/program performance can be controlled. By comparing the baseline with performance, deviations (or variances) from the baseline can be identified and corrected before they cause an impact on the project/program.

#### Technical Scope

As a project develops, some portion of the technical scope may be revised. If there is a deviation from the original technical scope, a change order is initiated and a revision to the original estimated cost usually occurs. Project control can use the detailed technical scope as well as the assumptions made by the estimator when assessing the cost impact of a change in scope. The detailed scope is used as a baseline, and all changes to it are documented by project controls.

#### Schedule

The schedule in the cost estimation package represents the same timeframe as the estimate. Therefore, any change in this schedule could affect the cost of the project/program. Thus, management can compare

the baseline schedule to the actual schedule to identify scheduling problems or changes, and any associated cost updates.

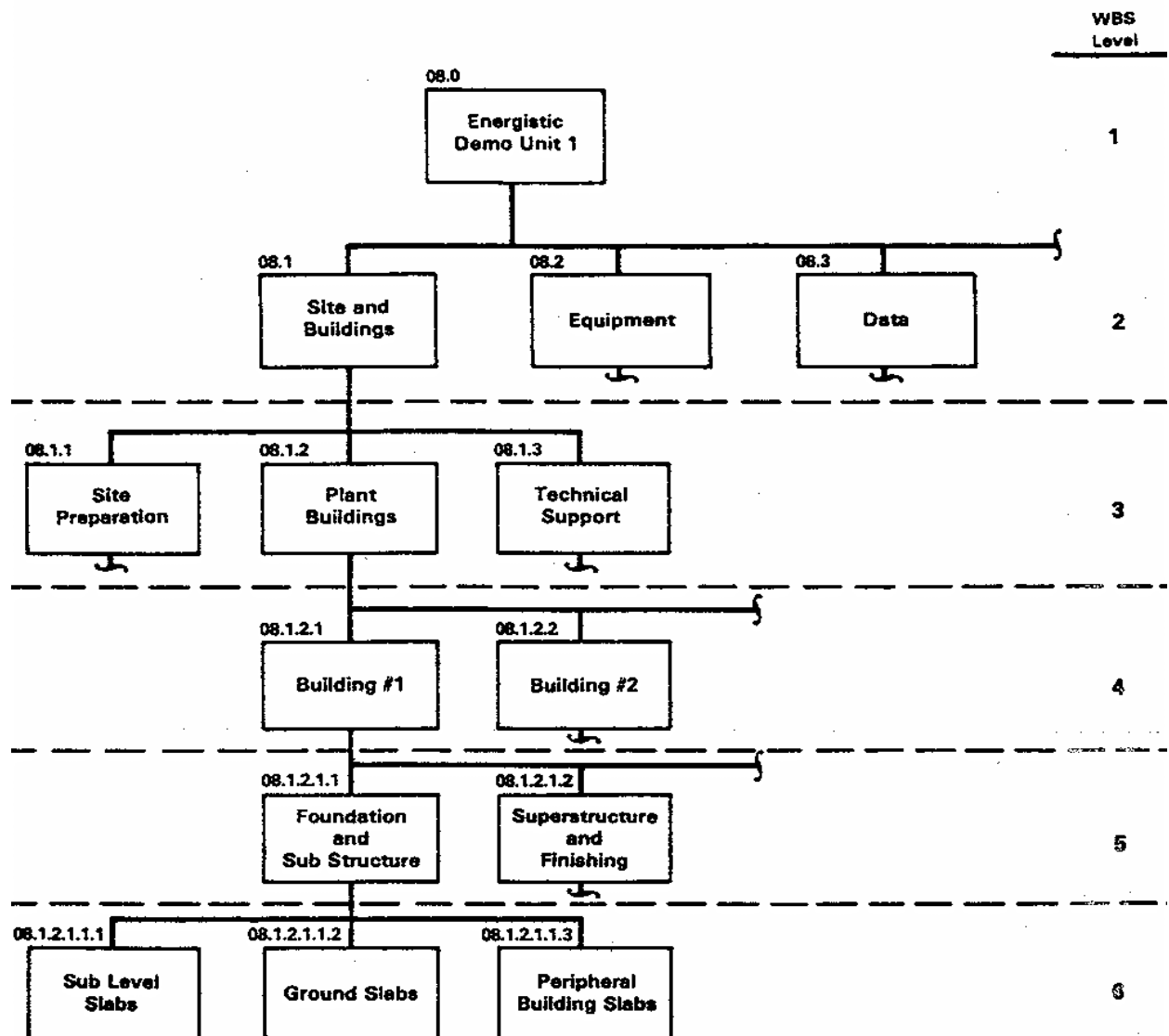
### **7.2.1 Work Breakdown Structure (WBS)**

A WBS is a numerical, graphic representation that completely defines the scope of a project / program by relating elements of work (or projects within a program) to each other and to the end product. The WBS is comprised of discrete work packages, called elements, that describe a specific item. Descending levels of the WBS provide elements of greater and greater detail. The number of levels of a WBS depends on the size and complexity of the project.

A WBS is the result of project/program planning which establishes the physical work packages or elements and the activities within those packages that completely define a project. It organizes the physical work packages into levels which can be developed into a summary. A WBS is the common link between a project / program technical scope, cost estimate, and schedule. A WBS is specific for a project, although it may have features similar to the upper level of the COA.

The WBS and the organization of the cost estimate set the precedence for all communication regarding technical scope, cost, and schedule throughout the life of the project. The same organization must be used by project controls to track changes against the baseline WBS element.

Since the WBS divides the project into work packages. The work packages or their activities can be used as the schedule's activities. This enables schedule development, and resource loading, resource budgeting, and also facilitates a variety of analyses. Figure 7-1 depicts a typical WBS. Every project and program may have a unique WBS.



**Figure 7-1 Typical Work Breakdown Structure**

### **7.2.2 Code of Accounts (COA)**

A COA is a breakdown of a project into controllable elements for the purpose of cost control and reporting. The breakdown is a numbered structure, organized in a logical manner, typically representing activities, which are discreetly defined. There are various COA, for varying purposes. For instance, the Environmental Cost Element Structure (ECES, formerly known as HTRW) represents a hierarchy of Life-Cycle phases and activities found within the DOE Environmental

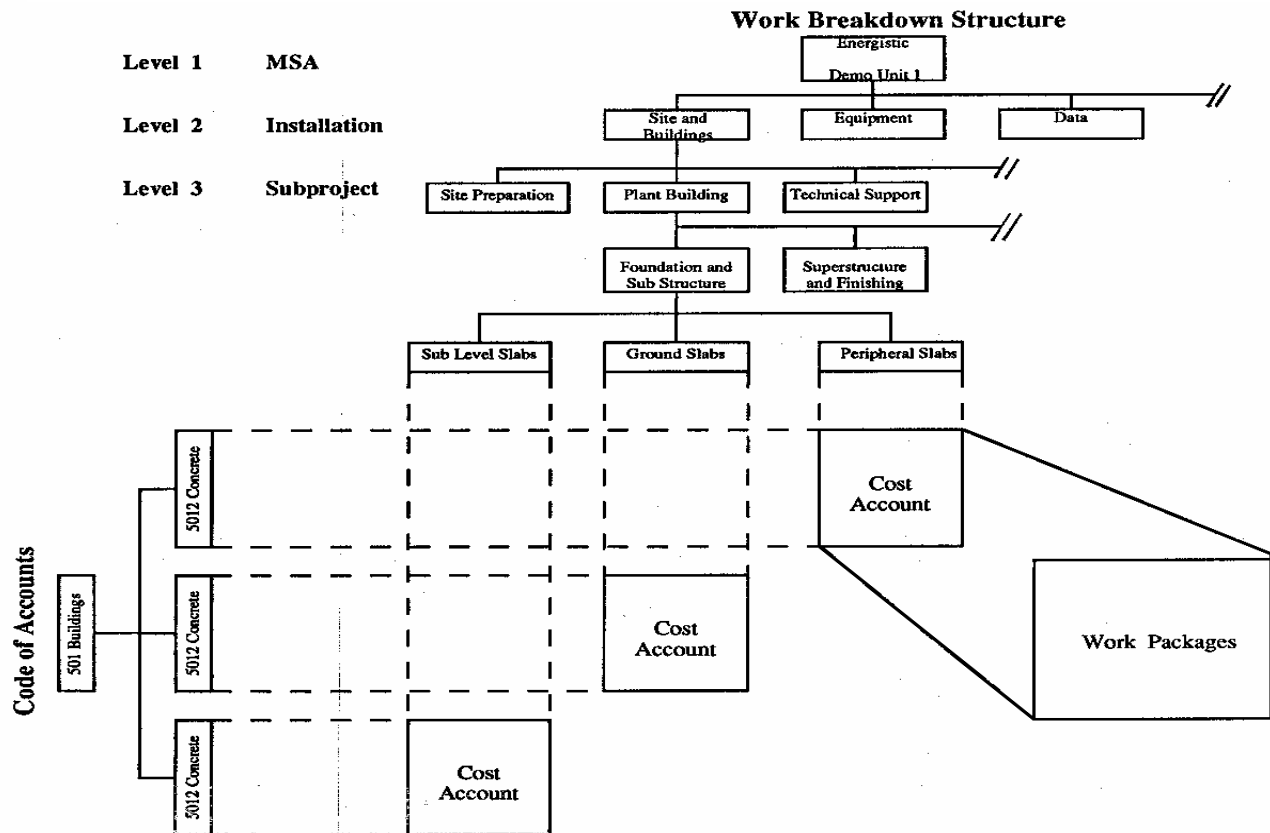
## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Management Program (EM) and the Construction Specification Institute (CSI) has a similar hierarchy of activities typically found within the construction industry. These COAs may be used as more specific guidance to be provided by DOE program and field offices.

The COA is used to organize the costs in a cost estimate. The COA should remain activity-based, to the most practical extent; functionally, it can easily become organizational. As a project progresses, the same COA are used but the data elements are updated. By comparing technical performance, costs, and schedules in elements of the COA during project execution, variances and trends can be identified. Final costs should provide accurate information regarding each COA. This historical cost information may then be used in preparing future cost estimates.

A project cost code guide should be provided for each line item construction project. The cost code system should be developed prior to the cost estimate supporting the CD for baseline approval. All subsequent cost estimates must then be made in accordance with the cost code system. Figure 7-2 depicts the relationship between a typical project WBS and COA.

**Figure 7-2. Work Breakdown Structure Extended to Cost Account and Work Package Levels  
Indicating Cross Walk to Code of Accounts**



### System Interface

Even though the numeric systems established for the WBS and COA differ, they are both based on a hierarchical structure that increases in detail as the levels increase. A correlation exists between the WBS and COA levels. This relationship is inherent, since there are costs associated with the execution of each work package or element of the WBS.

Use of a consistent cost codes and WBS will provide:

- A framework for standardization in cost estimating and accounting for costs
- A means for detecting omission and duplication of items in cost estimates
- A basis for comparing the cost of similar activities in different projects or at different locations
- A record of actual costs incurred on completed projects in a form that will be useful in the preparation of estimates for other projects
- A means of establishing the cost of property record units for proper asset management.

Standard COA's for construction and environmental projects are included in Appendices 9.4, 9.5, and 9.6.

### **Section 7.3 – Cost and Schedule Estimating Tools**

There are numerous cost and schedule estimating tools available commercially. In recent years there have been numerous analyses of these systems to determine appropriate uses in the DOE project environment. Most cost and schedule estimating tools have standard data fields, most of which are compatible with other systems. This is useful in providing data to accounting / budgeting / contracting systems, establishing project control systems and corresponding earned value information, etc.

For now, the policy on cost and schedule estimating tools, is that each program or field office should use what is most cost-effective and easiest to implement. In many cases, the simpler, the better. However, one system does not fit every situation. More complex systems are often-times complicated and cumbersome. Contractors should rely on current commercially-available and reliable systems, and work closely with the DOE program and field offices to determine what is best for situations.

## Section 7.4 - Life-Cycle Costing

Life-Cycle Costs (LCC) are all the anticipated costs associated with a project or program alternative throughout its life. This includes costs from pre-operations through operations, or through the end of the alternative. This chapter contains a discussion of LCC and Life-Cycle Cost Analysis (LCCA) and the role played in planning. Further information about the discount rates to be used in LCC analysis can be found in the Office of Management and Budget (OMB) Circular A-94, Economic Analysis.

LCCA is the systematic evaluation of alternatives within a project, with the objective of choosing the best alternative to employ resources; LCCA is used as a decision tool. The life-cycle should cover the entire life of the project and not an pre-determined time span (e.g., a five year plan). LCCA should always compare similar elements (i.e. apples or oranges).

By applying the principles of LCCA, it is possible to evaluate several building designs to support selection of the one with the lowest LCC. Figures 7-3 through 7-5 illustrate different views of project life cycles.

**Figure 7-3 Actions Affecting LCC**

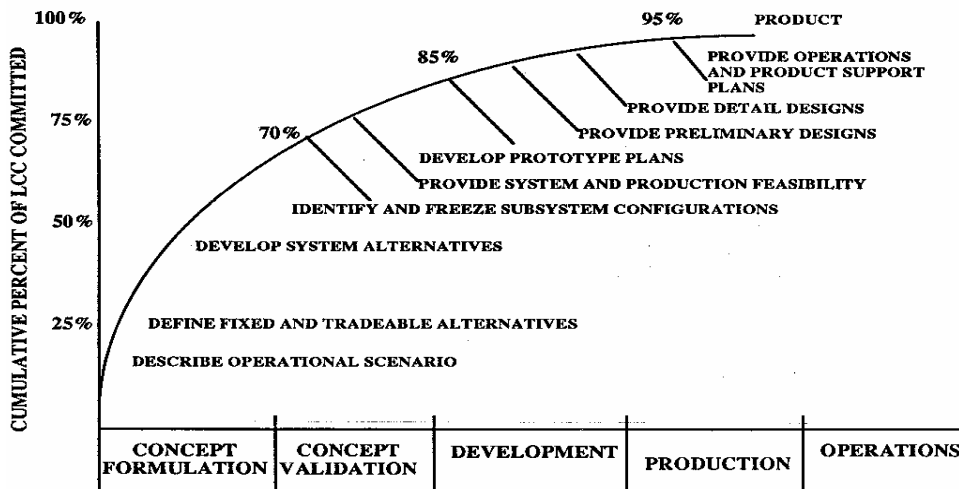


Figure 7-4 LCC Profile for System Acquisition

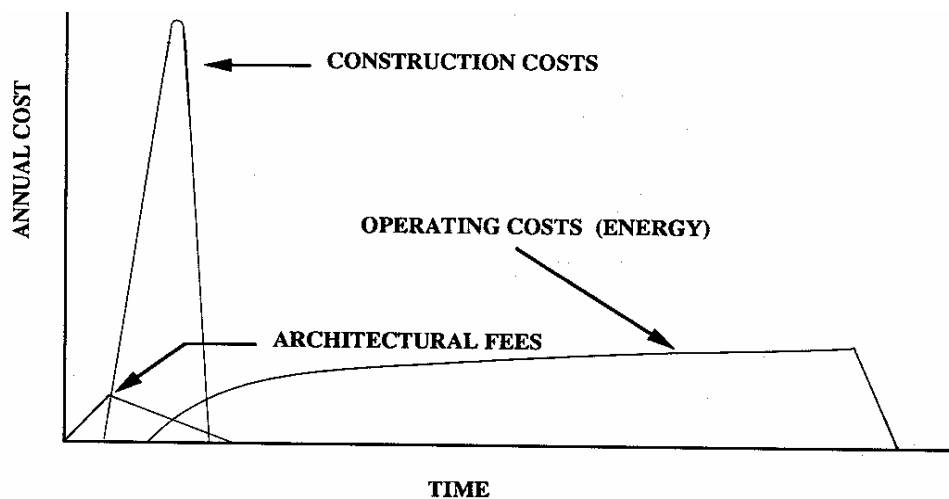
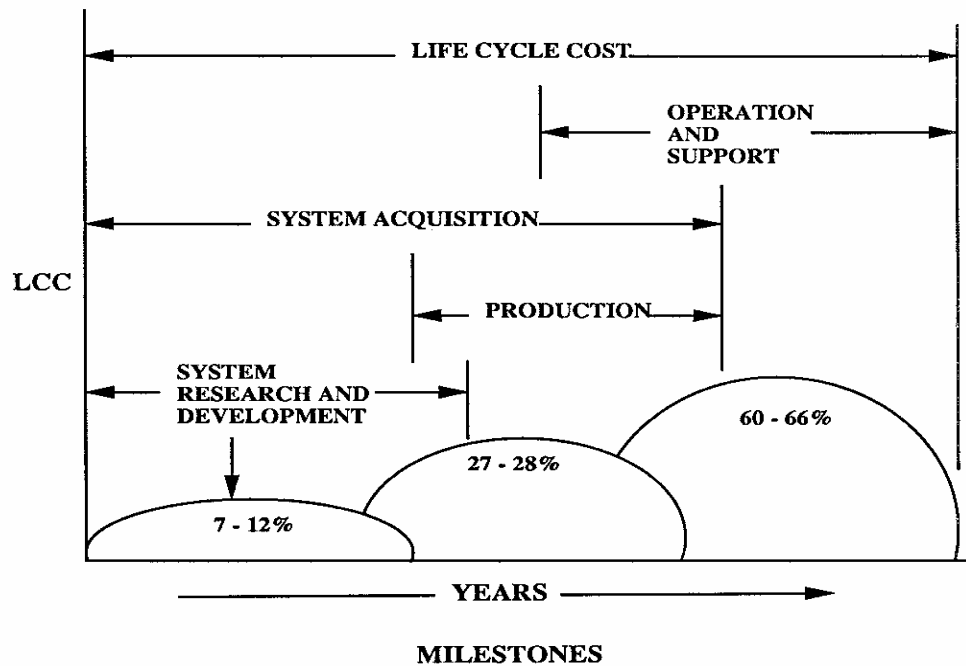


Figure 7-5. Stages of LCC

### LCCA Process

LCCA is employed to evaluate alternative design configurations, alternative manufacturing methods, alternative support schemes, etc. The LCCA process includes:

- Defining the problem or project scope
- Defining the requirements of the cost model being used
- Collecting historical data/cost relationships/cost data
- Defining the schedule
- Developing the estimate and analyzing the results

A successful LCCA application will:

- Forecast future resource needs which, when evaluated, can identify potential problems or impacts
- Influence R&D, or preliminary design decision-making
- Support future strategic planning and budgeting

LCCA limitations include:

- Estimating early in the life of a project when the degree of accuracy has a broad range
- Assuming that the alternative has a finite life cycle
- The high cost to perform the LCC analysis may not be appropriate for all projects
- A high sensitivity to changing requirements

LCCA is an integral part of strategic planning. Therefore, we need to understand the common errors made during LCC analysis so effective decisions can be made. The following lists some of the common errors made when performing LCC analysis that could affect the outcome:

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

- Omission of data
- Lack of a systematic structure or analysis
- Wrong or misused estimating techniques
- A concentration of wrong or insignificant facts
- Failure to assess uncertainty
- Failure to check work
- Estimating the wrong items
- Misinterpreted, incorrect, or inconsistent escalation data

LCCA must be performed early in project life or it loses its impact to make a cost effective decision on which alternative is best.

### LCCA Methods

LCCA consists of defining the LCC of each element and reducing each element cost to a common basis. This section discusses the methods of reducing the LCC to a common basis using present-worth calculations.

In LCCA, escalation and discount rates must be considered. The most commonly used method of LCCA uses the net present-worth method. In this method, costs are estimated in current dollars, escalated to the time when they would be spent, and then corrected to a present-worth using a discount rate. In an unlikely scenario where the inflation and discount rates are equal, LCC can be computed as current dollars, totaled for the project life, and then compared. When the escalation and discount rate are different, the escalation and present-worth calculations must be performed.

### **Section 7.5 - Activity-Based Costing (ABC)**

Activity-Based Costing (ABC) is a method for developing cost estimates in which the project is subdivided into discrete, quantifiable activities, or work units. The activity must be definable where productivity can be measured in units (e.g., number of samples versus man-hours). After the project is broken into its activities, a cost estimate is prepared for each activity. Individual cost estimates will contain all labor, materials, equipment, and subcontracting costs, including overhead, for each activity. Contingency and escalation can be calculated for each activity or after all the activities have been summed. ABC is not appropriate

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

for all cost estimates, particularly in the early stages of scope development.

### ABC Methodology

For many years, construction firms and industry trade groups have collected cost data from a multitude of different construction projects. The amount of work associated with that cost was also collected with the cost data. For example, collected data included the cost of the paint, labor, equipment, and overhead to paint a room, the amount of surface area painted, and the manpower required in painting the room. This practice allowed construction professionals to obtain a cost per area and manpower per area. These costs are based on an activity, such as painting, and are known as ABC.

### ABC Definition

ABC can be defined by the following equation:

$$C/A = H * D + M + E + S$$

Where:

C/A	Estimated cost per activity
H	Number of labor hours required to perform the activity one time
D	Wages per labor hour
M	Material costs required to perform the activity one time
E	Equipment costs to perform the activity one time
S	Subcontracting costs to perform the activity one time

The total cost for performing the activity will be based on the number of times the activity is performed during a specific time frame.

Cost estimators have assembled large databases of activity-based cost information. The R.S. Means Company, an excellent source of ABC information for the construction industry, updates its published cost references on a yearly basis.

### Use of ABC Methodology

ABC methodology is used when a project can be divided into defined activities. These activities are at the lowest function-level of a project at which costs are tracked and performance is evaluated. Depending on the project organization, the activity may coincide with an element of the WBS

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

or may combine one or more elements. However, the activities must be defined so there is no overlap between them. After the activity is defined, the unit of work is established. All costs for the activity are estimated using the unit of work.

The estimates for the units of work can be founded by performing detailed estimates, using Cost Estimating Relationships, and obtaining outside quotes for equipment, etc. All costs including overhead, profit, and markups should be included in the activity cost.

### Identification of Activities

When defining an individual activity, the cost estimator must balance the need for accuracy with the amount of time available to prepare the estimate. An estimator may be able to develop an extremely accurate cost estimate by defining smallest of activities; however, the amount of time required to prepare ABC estimates for each of these activities may not justify the increased accuracy. Reliable cost information may not be accessible if the activity categories are too general. Since the activity is the basis for the estimate, it is very important that the activity be selected correctly.

ABC estimating is especially useful in instances where the number of activities is uncertain, or may result in change during the estimate process. Referring back to the ABC estimate example, if the number of samples changed, it would be fairly easy to recalculate the cost of the sample.

### **Section 7.6 – TEC / OPC / TPC (APB)**

This section provides guidelines for activities to be included in project total estimated cost (TEC), other project costs (OPC), and total project cost (TPC). A more detailed guideline is provided in Appendix 9.7. The development of guidelines is important because it provides: standardization for estimating, reporting of costs, and uniformity of information used for cost databases.

Project TPC includes all costs specific to a project incurred through startup of a facility, but prior to the operation of the facility. So, TPC includes both the TEC and OPC. As a project gets formal acceptance of CD-2, baseline approval, the TPC becomes the acquisition performance baseline (APB).

$$\text{TEC} + \text{OPC} = \text{TPC (or APB)}$$

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

### Total Project Cost (TPC) / Acquisition Performance Baseline (APB)

As stated before, TPC includes all costs specific to a project incurred through the startup of a facility, and prior to the operation of a facility (for construction-type projects). TPC will include, but not be limited to, activities such as design and construction: contingency, economic escalation, pre-Title I activities, feasibility study reports, maintenance procedures (to support facility startup), one-time start-up costs, initial operator training, and commissioning costs, and operating procedures. These activities are all relative to successful project completion as an APB.

### Total Estimated Costs (TEC)

TEC is divided into costs associated with design, construction, and project management.

- Design - includes engineering and design activities in preliminary, intermediate, and definitive design stages. This also includes design activities during construction and project execution (e.g. design changes). This aspect establishes the project's functional requirements and performance objectives. This also provides input from the design disciplines, as in acquisition strategy, contract types, and technical constraints.
- Project Management - includes those services provided to the DOE on a specific project, beginning at the start of design and continuing through the completion of construction or project execution, for planning, organizing, directing, controlling, and reporting the status of the project.
- Construction - includes services provided by the organization responsible for management of the construction effort during preliminary design, and continuing through the completion of construction. This provides for all construction costs: materials, labor, tools, construction equipment, subcontracts, etc. Construction management salaries, administration costs, travel, and the expenses of engineers: specifically to support construction activities, quality assurance, submittals, and field input to the design effort, such as design changes are also included. When work normally performed by an architect/engineer (A/E) is performed by a construction contractor, the associated costs are charged to the applicable design accounts, e.g. Design-Build projects.
- Operations - includes all activities associated with start-up, operations interface, tie-ins to existing processes and/or

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

utilities. If a project is an operations-type project, most project activities would be associated with operations.

TEC generally includes: all engineering design costs (after conceptual), facility construction costs, and other costs specifically related to those construction efforts. These costs are typically capitalized. TEC includes, but is not limited to:

- Project management and construction management during preliminary design, definitive design, and project execution
- Design and construction management and reporting during design construction
- Contingency and economic escalation for TEC applied elements
- Contractor support directly related to design and construction
- Equipment and refurbishment

### Other Project Costs (OPC)

Any activities that are not representative of TEC functions are allocated to OPC. They are typically Pre-Title I activities, startup costs and some support functions.

OPC items include all other costs related to a project that are not included in the TEC such as supporting research and development, pre-authorizing costs prior to start of Title I design, supporting plants costs during construction, activation, and startup. OPC includes, but is not limited to: research and development, National Environmental Policy Act of 1969 (NEPA) documentation, Project Data Sheet (PDS) development, Conceptual Design Report (CDR), short form Project Data Sheet, surveying for siting, conceptual design plan, and evaluation of Resource Conservation and Recovery Act (RCRA)/U.S. Environmental Protection Agency (EPA)/state permit requirements.

Standard definition COA's are available in Appendices 9.4, 9.5, and 9.6. Those activities are identified, so it is possible to uniformly, consistently allocate and collect historical costs within various projects. This guide provides general information regarding TEC, OPC, and TPC. However, more detailed guidance may be provided by a DOE program or field office.

### **Section 7.7 - Breaches**

A breach is a relatively new term in the DOE project management arena. This occurs when the current estimate of a performance, technical, scope, cost, or schedule parameter is not within the threshold value (for the APB) constraint. It is handled as a deviation, not through the normal change control process.

Example: Projects in the RED - the SPI-PTD or CPI-PTD reported in PARS exceeds the limits established (below .85 or above 1.25). This would indicate some problems requiring management attention. These situations may require additional funding, additional resources, or special consideration to correct a specific deficient condition.

### **Section 7.8 - Earned Value**

DOE Order 413.3 applies to all DOE projects, in particular, those projects requiring significant planning and resources to be acquired. Controlling the planning, definition, execution, and close-out of those projects is a significant undertaking, which DOE senior management has a need to monitor. Cost and schedule control implies reporting and management attention. Earned value takes a cost estimate, spreads it over time, and predicts a S-curve expenditure to be reported against. Variance from that S-curve should be subjected to management attention, especially if the variances - cost variance (CV) or schedule variance (SV) - are outside some established boundaries.

DOE requires the use of EV and references the EV Standard EIA-748 and other earned value practices. EV project reporting is through PARS, as described in Chapter 2. Projects over \$20M require the use of EV to properly established cost and schedule estimates are required to perform EV.

#### **Cost and Schedule Estimates Used in EV**

Cost and schedule estimates are required for EV reporting. They are used to establish baselines, propose or implement changes, and are used to establish costs and time remaining in the project.

Cost and schedule estimates are typically organized by a WBS / Code of Accounts and are time-phased, to produce an S-curve, which should depict the entire project. This curve is to be used for regular status monitoring.



### Key Point

#### Cost vs. Obligations

From an accounting / budget execution perspective, funding should always precede costs incurred. When looking at a spend-out curve, it is important to note that the typical project S-Curve represents costs. Funding is required prior to those funds being obligated. A Funding Profile should typically lead an S-Curve. The lead time between obligating funds and costing those funds is subjective and should be managed appropriately.

Regardless of the estimate type, methods employed, or purposes, cost and schedule estimates are expected to contain a high level of quality, that is, to be consistent, well-documented, complete, and reasonable. Utilizing the minimum review criteria, all cost and schedule estimates are expected to contain escalation, contingency, direct, indirect costs, and pertinent life-cycle costs, for estimates depicting work remaining.

There are various methods of determining EACs. The primary methods are:

- 1) Using Cost Performance Indices (CPI) and Schedule Performance Indices (SPI), the EAC can be calculated.
- 2) Using the Scope of Work, and an understanding the work completed, a new cost and schedule estimate can be made to ascertain the cost and schedule of the remaining work.

Neither of these two methods is absolute for any particular situation. They should be used together, but not necessarily each time the project is reported. That would lead to either several, or no, cost estimators or schedulers associated with the project, since a project manager can calculate CPI and SPI to determine EAC, but continuous cost and schedule estimate updates would require more resources.

#### Use of Earned Value

Earned value is used by many different people in many different ways for many different purposes. EV is most used or referenced as an indicator of project performance. However, EV may also be used for contract billing, contract performance, fee determination (or calculation), trending or trend

## **DOE Cost and Schedule Estimating Guide – DRAFT February 2003**

analysis, and should be used regularly maintain project focus or to provide management attention to problematic areas. Project performance, using EV, may also help establish parameters for historical project data.

EV Analysis should be done regularly for a project. DOE's PARS requires monthly updates. Analysis should include an assessment of the current period CPI and SPI, as well as the Project-to-Date indices, CPI-PTD and SPI-PTD.

**Chapter 8 - EXAMPLES** 

Section 8.1 - Calculation and Use of Escalation

Section 8.2 - Calculation and Use of Contingency

Section 8.3 - Use of Life-Cycle Cost Analysis (LCA)

Section 8.4 - Use of Activity-Based Costing (ABC) and Level of Effort (LOE)  
Estimating

## **Section 8.1 – Calculation and Use of Escalation**

Escalation should be used in all estimates, where a project's TPC may be impacted due to increases in unit costs, due to inflation. The following is an example of a five-year project requiring Escalation.

Step 1 – Complete Cost and Schedule Estimates (Cost Estimate Purpose, Type, or Method does not matter, although it should be organized by the WBS).

Step 2 - Determine midpoint of primary scheduled activities. Typically, an upper level WBS is necessary to segregate types of activities (i.e. Design, Construction). It is not necessary to calculate Escalation at the lowest levels of activities, since most activities are grouped into logistical WBS elements.

Step 3 - Select Appropriate Escalation Rates. These rates are typically based on information provided by DOE/HQ, but may be based on locally documented information.

Step 4 - Calculate Escalation for each scheduled activity by using estimate preparation date as starting point and applying Escalation Rates selected in Step 3 to midpoint dates determined in Step 2. A straight-line spending curve application is may be assumed, although, other spending curves may be used, as appropriate.

The following Tables 8-1 through 8-4 represent the general steps in Calculating Escalation. Table 8-1 is an example of a hypothetical project Cost Estimate summary, prior to adding for Escalation.

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Table 8-1

### Sample Project Cost Estimate Summary

WBS	Scheduled Activity	Total Base Cost (000\$)	Start	Duration (Months)	Complete	Midpoint
A1A	Preliminary Design (Title I Design)	100	10/1/2002	6	3/30/2003	1/1/2003
A1B	Definitive Design (Title II Design)	200	4/1/2003	6	9/30/2003	7/1/2003
A1C	Design during Construction (Title III)	100	10/1/2003	36	9/30/2006	7/1/2005
B2A	Equipment Procurement (General Services)	200	10/1/2004	24	9/30/2006	10/1/2005
B2B	Equipment Procurement (Long-Lead, GFE)	2,500	3/30/2003	18	9/30/2004	1/1/2004
B2C	Facility Construction	6,000	10/1/2004	37	9/30/2006	10/1/2005
C1A	Project Management	500	10/1/2002	48	9/30/2006	10/1/2004
C1B	Construction Management	250	10/1/2002	48	9/30/2006	10/1/2004
C1C	Project Support	250	10/1/2002	48	9/30/2006	10/1/2004
<b>Totals</b>		<b>10,100</b>				

Table 8-2 is the DOE Escalation Rates (as of January 2002), available through the DOE Budget Formulation Handbook, and from the Office of Engineering and Construction Management (ME-90) for projects. Rates used may be different from those provided by DOE, however, there should be a sound basis for Escalation Rates used.

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Table 8-2

**Escalation Rate Assumptions  
For DOE Projects  
(as of January 2002)**

FY	Project Categories *									
	Construction		EM		IT		O&M		R&D	
2002	1	N/A	1	N/A	1	N/A	1	N/A	1	N/A
2003	1.021	2.1	1.02	2	1.008	0.8	1.018	1.8	1.023	2.3
2004	1.046	2.5	1.047	2.7	1.017	0.9	1.045	2.6	1.051	2.8
2005	1.076	2.9	1.075	2.7	1.022	0.5	1.073	2.7	1.08	2.7
2006	1.106	2.8	1.103	2.6	1.032	1	1.101	2.6	1.108	2.6
2007	1.135	2.6	1.13	2.4	1.041	0.8	1.127	2.4	1.136	2.5

Table 8-3 is an example of a detailed spread of Escalation Rates through the applicable Fiscal Years. This example assumes a straight-line Escalation for each FY, although other applications may be appropriate (i.e. all at the beginning or end of a FY). Other than straight-line escalation should be well-documented.

Table 8-3

**Sample Detailed Spread of Escalation Rates**

Months of Escalation		0	1	2	3	4	5	6	7	8	9	10	11	12
Month of the Year (Mid-Point)		10	11	12	1	2	3	4	5	6	7	8	9	10
FY	Rate													
2002	2.10%	0.00%	0.17%	0.35%	0.52%	0.70%	0.87%	1.05%	1.22%	1.40%	1.57%	1.75%	1.92%	2.10%
2003	2.10%	2.10%	2.28%	2.46%	2.64%	2.81%	2.99%	3.17%	3.35%	3.53%	3.71%	3.89%	4.07%	4.24%
2004	2.50%	4.24%	4.46%	4.68%	4.90%	5.11%	5.33%	5.55%	5.76%	5.98%	6.20%	6.42%	6.63%	6.85%
2005	2.90%	6.85%	7.11%	7.37%	7.62%	7.88%	8.14%	8.40%	8.66%	8.92%	9.17%	9.43%	9.69%	9.95%
2006	2.80%	9.95%	10.21%	10.46%	10.72%	10.98%	11.23%	11.49%	11.74%	12.00%	12.26%	12.51%	12.77%	13.03%
2007	2.60%	13.03%	13.27%	13.52%	13.76%	14.01%	14.25%	14.50%	14.74%	14.99%	15.23%	15.48%	15.72%	15.97%
2008	2.60%	15.97%	16.22%	16.47%	16.72%	16.97%	17.22%	17.47%	17.72%	17.98%	18.23%	18.48%	18.73%	18.98%

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Table 8-4 is an example of the Project Cost Estimate Summary with columns added to calculate the Escalation, per WBS element.

Table 8-4

### Sample Project Cost Estimate Summary, including Escalation

WBS	Scheduled Activity	Total Base Cost (000\$)	Start	Duration (Months)	Complete	Midpoint	Compounded Escalation Rate	Total Escalated Costs (000\$)
A1A	Preliminary Design (Title I Design)	100	10/1/2002	6	3/30/2003	1/1/2003	2.64%	103
A1B	Definitive Design (Title II Design)	200	4/1/2003	6	9/30/2003	7/1/2003	3.71%	207
A1C	Design during Construction (Title III)	100	10/1/2003	36	9/30/2006	7/1/2005	9.17%	109
B2A	Equipment Procurement (General Services)	200	10/1/2004	24	9/30/2006	10/1/2005	9.95%	220
B2B	Equipment Procurement (Long-Lead, GFE)	2,500	3/30/2003	18	9/30/2004	1/1/2004	4.90%	2,623
B2C	Facility Construction	6,000	10/1/2004	37	9/30/2006	10/1/2005	9.95%	6,597
C1A	Project Management	500	10/1/2002	48	9/30/2006	10/1/2004	6.85%	534
C1B	Construction Management	250	10/1/2002	48	9/30/2006	10/1/2004	6.85%	267
C1C	Project Support	250	10/1/2002	48	9/30/2006	10/1/2004	6.85%	267
<b>Totals</b>		<b>10,100</b>						<b>10,927</b>

In calculating applicable Escalation percentages, repetitive calculations are normal, so a computerized Escalation forecast program may prove beneficial. Cash flow may be assumed to be straight-line or based on a spending curve, as appropriate.



#### Key Point

#### Cost vs. Obligations - Funding Profile

A funding profile is a normal part of budget submissions. There is a difference between the timing of project costs and obligations / funding requirements. As a project evolves, it should be very clear that funds are required prior to spending them. This lead time should be carefully evaluated and established by the project team. Care should be taken to establish the most appropriate funding profile to provide for efficient use of funds, and to minimize carry-over (funds not obligated within the FY they are authorized).

## **DOE Cost and Schedule Estimating Guide – DRAFT February 2003**

It is also necessary to use common sense in applying Escalation. For instance, if Construction Subcontract is let for a competitive fixed price, and will cover multiple fiscal Years, it may not be necessary to apply Escalation to that contract, if already let. However, if it is still an estimate of what that subcontract may be, Escalation may very well be applicable, as in the example.

Once Escalation has been applied, it is not normally necessary to re-consider how it is applied, except in the context of change control. There are instances where it is pertinent to consider how much escalation is applied to unit costs and hourly labor rates. These types of analyses may become quite complex, although, having a systematic approach to estimating Escalation may help.

## **Section 8.2 – Calculation and Use of Contingency**

### Section 8.2.1 - Deterministic Approach

### Section 8.2.2 - Probabilistic Approach

The Deterministic Approach in calculating Management Reserve (MR) and Contingency is to be used for with the smaller, simpler projects, and especially in the early phases of a projects life. As a project evolves, projects are expected to use a more Probabilistic Approach in establishing MR and Contingency. MR and Contingency should always be calculated with a projects remaining costs, not yet incurred, as in an Estimate to Complete.

### **Section 8.2.1 - Steps in Calculating MR and Contingency using a Deterministic Approach**

The follow steps are an example of how to calculate Management Reserve (MR) and Contingency using a deterministic approach. These steps are generic and should be considered appropriately, but used consistently for like projects. The Deterministic Approach is most appropriate for smaller, simpler projects, and especially in the early stages of a project.

Step 1 - Determine Base Cost Estimate. Have a Summary Cost and Schedule Estimate (escalated), organized by the WBS.

Step 2 - Determine Risks associated with each WBS element, from consulting with the project team.

Step 3 - Determine percentages and / or amounts of Contingency, necessary to provide high and higher confidence levels, for each WBS element. (Percentages for Contingency and confidence levels are for example only. Remember, requirements are for projects to ascertain project risks and provide resources for a successful project.)

Step 4 - Calculate Management Reserve and Contingency, as appropriate.

Step 5 - Segregate Management Reserve (Contractor Contingency) into a specific Control Account.

Step 6 - Segregate Contingency (DOE-held) into specific Control Account to be used in change control, as necessary.

The following Example is generic, but includes the pertinent steps in calculating

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Contingency, using a Deterministic approach.

Step 1 - Determine Base Cost Estimate. Have a Summary Cost and Schedule Estimate (escalated), organized by the WBS. Table 8-5 shows a hypothetical Project Cost Estimate Summary (escalated), prior to adding MR and Contingency.

Table 8-5

Example

### Project Cost Estimate Summary (Escalated)

WBS	Scheduled Activity	Total Base Cost (000\$)	Total Escalated Costs (000\$)
A1A	Preliminary Design (Title I Design)	100	103
A1B	Definitive Design (Title II Design)	200	207
A1C	Design during Construction (Title III)	100	109
B2A	Equipment Procurement (General Services)	200	220
B2B	Equipment Procurement (Long-Lead, GFE)	2,500	2,623
B2C	Facility Construction	6,000	6,597
C1A	Project Management	500	534
C1B	Construction Management	250	267
C1C	Project Support	250	267
D	Management Reserve (MR)		
E	Contingency		
	<b>Totals</b>	<b>10,100</b>	<b>10,927</b>

Step 2 - From consulting with the IPT, determine risks associated with each WBS element. Table 8-6 provides an example of a simple Risk Assessment, organized by WBS.

**Table 8-6**

**Example**

**Project Risk Assessment**

<b>WBS</b>	<b>Scheduled Activity</b>	<b>Risks</b>
A1A	Preliminary Design (Title I Design)	Low Risks. Not very complex or complicated. Material and Equipment Vendors contacted, but not confirmed. Some risks in incorporating stakeholder input.
A1B	Definitive Design (Title II Design)	Moderate Risks. Mostly commercially available technology, standard details, high degree of quality. Minor risks in General and Special Equipment procurement and compatibility.
A1C	Design during Construction (Title III)	Moderate risks. High degree of quality could hamper construction acceptance, may necessitate changes.
B2A	Equipment Procurement (General Services)	Low risks.
B2B	Equipment Procurement (Long-Lead, GFE)	Moderate Risks. Some equipment may not be able to be delivered to meet construction schedule. Tightened oversight may help.
B2C	Facility Construction	Low to moderate risks. Mostly commercial construction techniques. Standards higher than normal. Equipment delivery questionable.
C1A	Project Management	Low risk.
C1B	Construction Management	Moderate Risks.
C1C	Project Support	Moderate Risks. Especially oversight for Special Equipment delivery.

Step 3 - Determine percentages and / or amounts of Contingency, necessary to provide high confidence levels, for each WBS element. (Percentages for confidence levels are for example only. Remember, requirements are for projects to ascertain project risks and provide resources for a successful project.)

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Table 8-7

Example

Project Cost Estimate Summary,  
with MR and Contingency Percentages

WBS	Scheduled Activity	Risks	Total Contingency Percentage	Total Escalated Costs (000\$)	MR (80%) <sup>1</sup>	Contingency (20%) <sup>2</sup>	Total Project Costs
A1A	Preliminary Design (Title I Design)	Low Risks. Not very complex or complicated. Material and Equipment Vendors contacted, but not confirmed. Some risks in incorporating stakeholder input.	10%	103	8	2	103
A1B	Definitive Design (Title II Design)	Moderate Risks. Mostly commercially available technology, standard details, high degree of quality. Minor risks in General and Special Equipment procurement and compatibility.	15%	207	25	6	207
A1C	Design during Construction (Title III)	Moderate risks. High degree of quality could hamper construction acceptance, may necessitate changes.	15%	109	13	3	109
B2A	Equipment Procurement (General Services)	Low risks.	10%	220	18	4	220
B2B	Equipment Procurement (Long-Lead, GFE)	Moderate Risks. Some equipment may not be able to be delivered to meet construction schedule. Tightened oversight may help.	20%	2,623	420	105	2,623
B2C	Facility Construction	Low to moderate risks. Mostly commercial construction techniques. Standards higher than normal. Equipment delivery questionable.	20%	6,597	1,056	264	6,597
C1A	Project Management	Low risk.	10%	534	43	11	534
C1B	Construction Management	Moderate Risks.	15%	267	32	8	267
C1C	Project Support	Moderate Risks. Especially oversight for Special Equipment delivery.	20%	267	43	11	267
D	Management Reserve				1,656		1,656
E	Contingency					414	414
	<b>Total</b>			<b>10,927</b>	<b>1,656</b>	<b>414</b>	<b>12,998</b>

Notes:

1 - Provides a relatively high degree of confidence.

2 - Provides for a higher degree of confidence.

Step 4 - Calculate Management Reserve (Contractor Contingency, representing a high confidence level) and Contingency (DOE-held, representing a higher confidence level), as appropriate. These confidence levels should provide for a successful project, representing a potential Contractor Budget Base (CBB) and Acquisition Performance Baseline (APB). Table 8-8 provides an example for the calculation of MR and Contingency, and depicts the TPC and potential CBB.

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Table 8-8

Example

### Management Reserve and Contingency Calculation

WBS	Scheduled Activity	MR and Contingency Percentage	Total Escalated Costs (000\$)	MR (000\$) <sup>1</sup>	Total Contractor Costs (000\$) (CBB)	Contingency (000\$) <sup>2</sup>	Total Project Costs (000\$) (APB)
A1A	Preliminary Design	10%	103	8	103	2	103
A1B	Definitive Design	15%	207	25	207	6	207
A1C	Design during Construction	15%	109	13	109	3	109
B2A	Equipment Procurement (General Services)	10%	220	18	220	4	220
B2B	Equipment Procurement (Long-Lead, GFE)	20%	2,623	420	2,623	105	2,623
B2C	Facility Construction	20%	6,597	1,056	6,597	264	6,597
C1A	Project Management	10%	534	43	534	11	534
C1B	Construction Management	15%	267	32	267	8	267
C1C	Project Support	20%	267	43	267	11	267
D	Management Reserve			1,656	1,656		1,656
E	Contingency					414	414
<b>Total</b>			<b>10,927</b>	<b>1,656</b>	<b>12,584</b>	<b>414</b>	<b>12,998</b>

Notes:

1 - Provides a relatively high degree of confidence.

2 - Provides for a higher degree of confidence.

Considerations for percentages used should include: Completeness of design, types of construction, contract types to be employed; estimate types, purposes, and methods; technologies available, reliability, co-occupancy / accessibility, environmental conditions, planning complexity (stakeholder involvement), and other unique items such as permitting and external reviews.

**Section 8.2.2. - Steps in Calculating MR and Contingency using a Probabilistic Approach**

The follow steps are an example of how to calculate MR and Contingency using a Probabilistic approach. These steps are generic and should be considered appropriately, but used consistently for like projects. The Probabilistic Approach is most appropriate in the later stages of a project.

Steps in Calculating Contingency

Step 1 - Determine Base Cost Estimate.

Step 2 - Determine risks associated with each WBS element.

Step 3 - Determine Best, Expected, and Worst Case Cost Scenarios for each WBS element.

Step 4 - Run Monte Carlo Simulation.

Step 5 - Determine amounts of MR and Contingency.

Step 6 - Establish the CBB and the APB.

Step 7 - Segregate the MR and Contingency into separate Control Accounts.

The following example of a Probabilistic Approach in determining Contingency is generic and should be considered appropriately and consistently for like projects.

Step 1 - Determine Base Cost Estimate. Have a Summary Cost and Schedule Estimate to work with, organized by the WBS.

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Table 8-9

Example

### Project Cost Estimate Summary (Escalated)

WBS	Scheduled Activity	Total Base Cost (000\$)	Total Escalated Costs (000\$)
A1A	Preliminary Design (Title I Design)	100	103
A1B	Definitive Design (Title II Design)	200	207
A1C	Design during Construction (Title III)	100	109
B2A	Equipment Procurement (General Services)	200	220
B2B	Equipment Procurement (Long-Lead, GFE)	2,500	2,623
B2C	Facility Construction	6,000	6,597
C1A	Project Management	500	534
C1B	Construction Management	250	267
C1C	Project Support	250	267
D	Management Reserve (MR)		
E	Contingency		
	<b>Totals</b>	<b>10,100</b>	<b>10,927</b>

Step 2 - From consulting with the IPT, determine risks associated with each WBS element. Table 8-10 is an example of a simple Risk Assessment.

Table 8-10

Example

Project Risk Assessment

WBS	Scheduled Activity	Risks
A1A	Preliminary Design (Title I Design)	Low Risks. Not very complex or complicated. Material and Equipment Vendors contacted, but not confirmed. Some risks in incorporating stakeholder input.
A1B	Definitive Design (Title II Design)	Moderate Risks. Mostly commercially available technology, standard details, high degree of quality. Minor risks in General and Special Equipment procurement and compatibility.
A1C	Design during Construction (Title III)	Moderate risks. High degree of quality could hamper construction acceptance, may necessitate changes.
B2A	Equipment Procurement (General Services)	Low risks.
B2B	Equipment Procurement (Long-Lead, GFE)	Moderate Risks. Some equipment may not be able to be delivered to meet construction schedule. Tightened oversight may help.
B2C	Facility Construction	Low to moderate risks. Mostly commercial construction techniques. Standards higher than normal. Equipment delivery questionable.
C1A	Project Management	Low risk.
C1B	Construction Management	Moderate Risks.
C1C	Project Support	Moderate Risks. Especially oversight for Special Equipment delivery.

Step 3 - Determine Best, Expected, and Worst Case Cost Scenarios, with probability distributions (Triangular, Beta, Normal, etc.) for each WBS element. Table 8-11 is an example of a table provided by the project team depicting best, expected, and worst cases for each summary WBS element.

Table 8-11  
Example  
Cost Estimate Summaries of  
Best / Expected / Worst Cases

WBS	Scheduled Activity	Risks	Total Escalated Costs (000\$) (Expected Case)	Best Case	Worst Case
A1A	Preliminary Design (Title I Design)	Low Risks. Not very complex or complicated. Material and Equipment Vendors contacted, but not confirmed. Some risks in incorporating stakeholder input.	103	100	105
A1B	Definitive Design (Title II Design)	Moderate Risks. Mostly commercially available technology, standard details, high degree of quality. Minor risks in General and Special Equipment procurement and compatibility.	207	185	225
A1C	Design during Construction (Title III)	Moderate risks. High degree of quality could hamper construction acceptance, may necessitate changes.	109	100	125
B2A	Equipment Procurement (General Services)	Low risks.	220	200	250
B2B	Equipment Procurement (Long-Lead, GFE)	Moderate Risks. Some equipment may not be able to be delivered to meet construction schedule. Tightened oversight may help.	2,623	2,600	2,700
B2C	Facility Construction	Low to moderate risks. Mostly commercial construction techniques. Standards higher than normal. Equipment delivery questionable.	6,597	6,500	7,000
C1A	Project Management	Low risk.	534	500	600
C1B	Construction Management	Moderate Risks.	267	250	300
C1C	Project Support	Moderate Risks. Especially oversight for Special Equipment delivery.	267	250	300
<b>Total</b>			<b>10,927</b>	<b>10,685</b>	<b>11,605</b>

Step 4 - Run Monte Carlo Simulation. Utilizing the best, expected, and worst cases, and a probability distribution curve, use Monte Carlo simulation to depict a distribution of the likely scenarios.

Figure 8-12

Example

Results of Monte Carlo Simulation

(Cumulative Distribution)

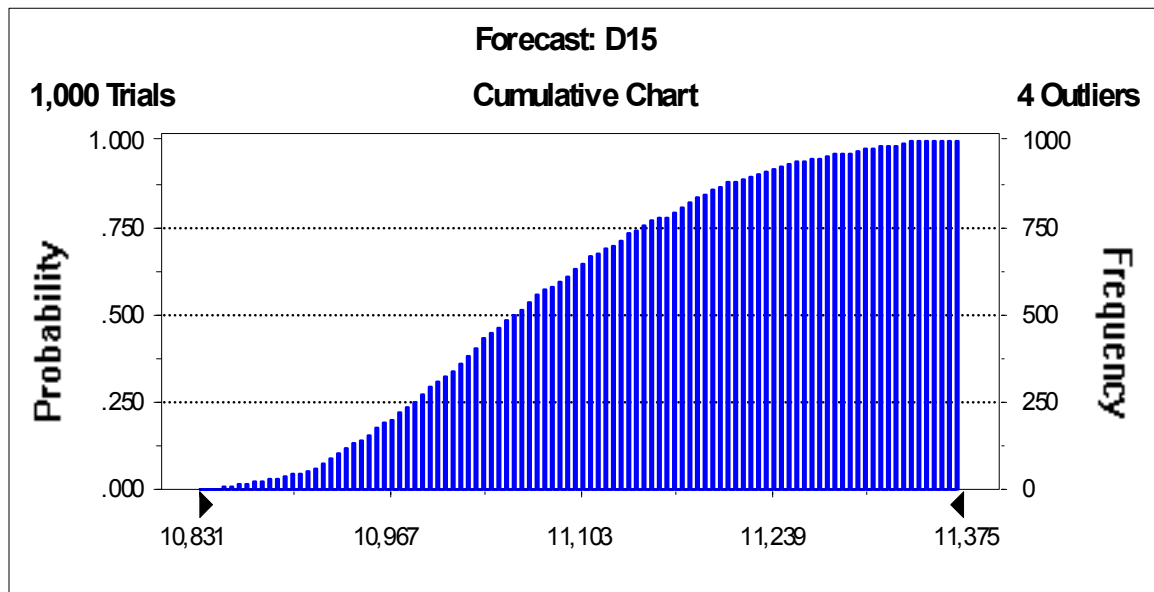


Figure 8-13

Example

Result of Monte Carlo Simulation

(Cumulative Distribution, with highlighted ~85% Confidence Level)

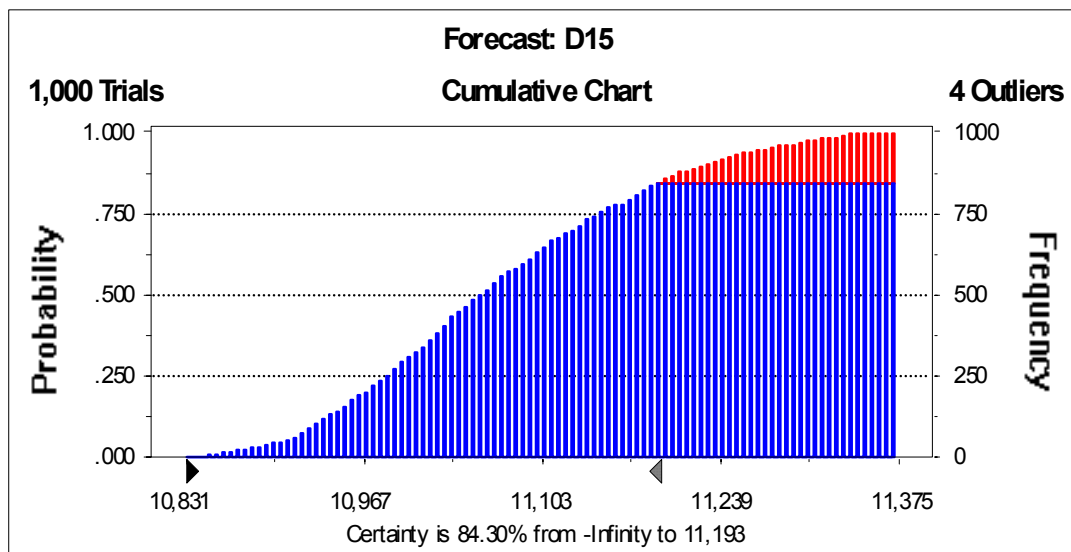
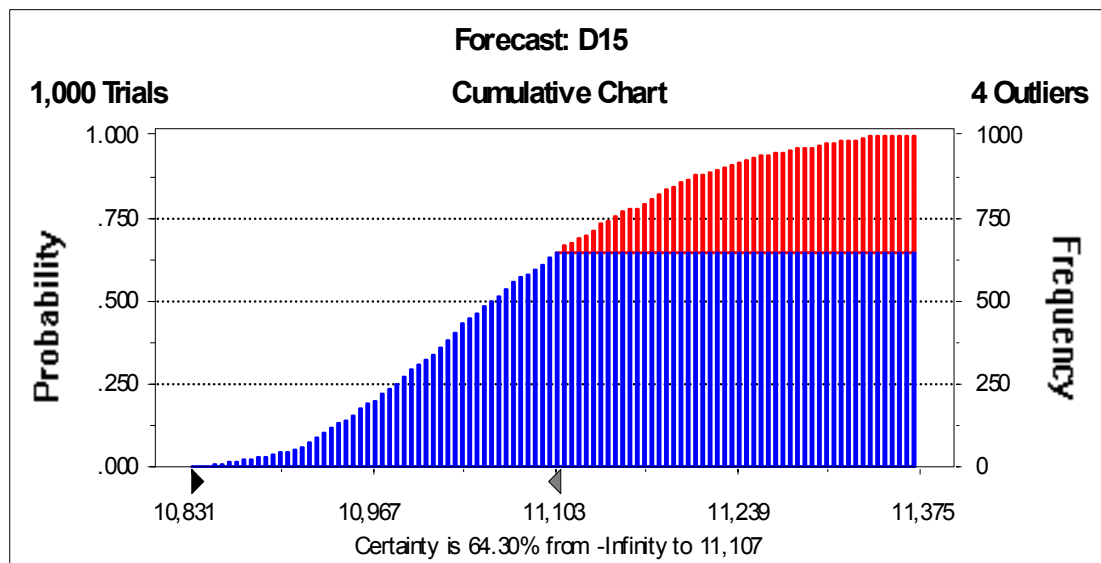


Figure 8-13

Example

Result of Monte Carlo Simulation

(Cumulative Distribution, with highlighted ~65% Confidence Level)



Step 5 - From the Monte Carlo simulation, determine amounts of MR and Contingency, necessary for each WBS element, to represent a contractors' confidence level and the DOE's confidence level. Table 8-14 depicts a table form of the results of the Monte Carlo Simulation.

Table 8-14

Example

Expression of Monte Carlo Simulation results in Table form

WBS	Scheduled Activity	Total Escalated Costs (000\$)	Confidence Level	
			65%	85%
			Total Project Costs (000\$)	Total Project Costs (000\$)
A1A	Preliminary Design	103	104	105
A1B	Definitive Design	207	211	212
A1C	Design during Construction	109	111	112
B2A	Equipment Procurement (General Services)	220	224	225
B2B	Equipment Procurement (Long-Lead, GFE)	2,623	2,666	2,686
B2C	Facility Construction	6,597	6,706	6,758
C1A	Project Management	534	543	547
C1B	Construction Management	267	272	274
C1C	Project Support	267	272	274
D	Management Reserve			
E	Contingency (DOE-Held)			
	<b>Total</b>	<b>10,927</b>	<b>11,107</b>	<b>11,193</b>

Step 6 - Establish the Contractor Budget Baseline (the CBB, including MR, or Contractor Contingency, to represent a high confidence level) and the Acquisition Performance Baseline (including DOE-held Contingency, representing a higher confidence level), as appropriate. These should provide Confidence Levels to provide for a successful project.

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Table 8-15

Example

Calculation of the CBB and the APB

WBS	Scheduled Activity	Total Escalated Costs (000\$)	MR (000\$)	CBB (000\$)	DOE-Held Contingency (000\$)	Total Project Costs (000\$) (TPC / APB)
A1A	Preliminary Design	103	2	103	1	103
A1B	Definitive Design	207	3	207	2	207
A1C	Design during Construction	109	2	109	1	109
B2A	Equipment Procurement (General Services)	220	4	220	2	220
B2B	Equipment Procurement (Long-Lead, GFE)	2,623	43	2,623	21	2,623
B2C	Facility Construction	6,597	109	6,597	52	6,597
C1A	Project Management	534	9	534	4	534
C1B	Construction Management	267	4	267	2	267
C1C	Project Support	267	4	267	2	267
D	Management Reserve		180	180		180
E	Contingency (DOE-Held)				86	86
<b>Total</b>		<b>10,927</b>		<b>11,107</b>		<b>11,193</b>

7) Segregate Management Reserve (MR, or Contractor Contingency) and Contingency (DOE-held Contingency) into distinct Control Account, for use in change control, as necessary.

Table 8-15

Example

Segregation of MR and Contingency  
into Separate Control Accounts

WBS	Scheduled Activity	Total Project Costs (000\$) (TPC / APB)
A1A	Preliminary Design	103
A1B	Definitive Design	207
A1C	Design during Construction	109
B2A	Equipment Procurement (General Services)	220
B2B	Equipment Procurement (Long-Lead, GFE)	2,623
B2C	Facility Construction	6,597
C1A	Project Management	534
C1B	Construction Management	267
C1C	Project Support	267
D	Management Reserve	180
E	Contingency (DOE-Held)	86
<b>Total</b>		<b>11,193</b>

### **Section 8.3 - Use of Life-Cycle Cost Analysis**

[A standard for Life-Cycle Cost Analysis (LCCA) is being established by the National Institute for Science and Technology. This example will follow and reference that information when available.]

OMB A-94 - Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, provides direction in performing Cost-Benefit Analyses, or Life-Cycle Cost Analyses (LCCA). Per OMB, LCCA's should always consider all pertinent Costs and Benefits. Due to the nature of projects considered in fulfilling missions of the DOE, LCCA's may include a component of benefits, which may be depicted as costs-to-be-avoided or saved, as a result of a particular alternative. DOE has very few, if any income or revenue streams. However, as a part of Life-Cycle Analyses, all benefits and costs should be recognized, including those that are difficult to quantify, such as benefits to the public or the general economy.

Generally the steps in performing LCCA is as follows:

Step 1 - Determine Cost Estimate Summary funding profile for Base Case and for each Alternative Case, including all Costs and Benefits.

Step 2 - Determine appropriate discount rates to be used. Note discussion on Real and Nominal Discount Rates. If Escalation is included in the Cost Estimate Summary, use Nominal Discount Rates established by OMB.

Step 3 - Calculate Present Worth of Base Case and each Alternative Case.

Step 4 - Compare all alternatives and determine the most cost-effective alternative. The lowest PW is the preferred alternative, from an economic perspective.

The Following example generally shows the steps to be used in performing LCCA:

Step 1 - Determine Cost Estimate Summary funding profile for Base Case and each Alternative Case being considered, including all Costs and Benefits. It is important to assure that similar functions and activities are considered similarly (i.e. consistent use of a WBS/COA), to provide as comparable scenario as possible. Table 8-16 and 8-17 are example of these summary tables.

Table 8-16

Example

Life-Cycle Cost Estimate Summary, Base Case

	Activity	TPC	03	04	05	06	07	08	09	10	11	12	13	14	15
A1A	Preliminary Design	103	103												
A1B	Definitive Design	207	207												
A1C	Design during Construction	109		37	37	36									
B2A	Equipment Procurement (General Services)	220			110	110									
B2B	Equipment Procurement (Long-Lead, GFE)	2,623	2000	623											
B2C	Facility Construction	6,597	1500	3597	1500										
C1A	Project Management	534	75	175	109										
C1B	Construction Management	267	25	100	42										
C1C	Project Support	267	25	100	42										
D	Management Reserve	180	25	75	5										
E	Contingency (DOE+Held)	86	10	25	25	26									
<b>Total Project Costs (Escalated)</b>		<b>11,193</b>	<b>2,470</b>	<b>2,635</b>	<b>4,219</b>	<b>1,870</b>	-	-	-	-	-	-	-	-	-
		<b>Annual</b>													
F	Operations (LOE)	250			269	277	284	291	299	307	315	323	331	340	349
G	Security (LOE)	100			108	111	114	117	120	123	126	129	132	136	139
H	Infrastructure (LOE)	50			54	55	57	58	60	61	63				
I	Maintenance (LOE)	100			108	111	114	117	120	123	126	129	132	136	139
J	Transition (LOE)	50										65	66	68	70
K	Decontamination (LOE)	50									63	65	66	68	70
L	Decommissioning (LOE)	50									63	65	66	68	70
M	Demolition (LOE)	500										646	662	680	697
<b>Total Operations (Escalated)</b>		<b>21,572</b>	<b>2,470</b>	<b>2,897</b>	<b>4,757</b>	<b>2,424</b>	<b>568</b>	<b>583</b>	<b>598</b>	<b>613</b>	<b>755</b>	<b>1,420</b>	<b>1,457</b>	<b>1,495</b>	<b>1,534</b>
<b>Total Life-Cycle Costs (Escalated)</b>		<b>32,765</b>	<b>4,940</b>	<b>5,532</b>	<b>8,976</b>	<b>4,294</b>	<b>568</b>	<b>583</b>	<b>598</b>	<b>613</b>	<b>755</b>	<b>1,420</b>	<b>1,457</b>	<b>1,495</b>	<b>1,534</b>

# DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Table 8-17

Example

Life-Cycle Cost Estimate Summary, Alternative Case

		TPC	03	04	05	06	07	08	09	10	11	12	13	14	15
<b>Activity</b>															
A	Design during Construction / Renovation	50													
	B2A Procurement / Lease Facility	1,560	102	105	108	111	114	117	120	123	126	129	132	136	139
	B2C Facility Construction / Renovation	6,597		1500	3597	1500									
	C1A Project Management	150	25	50	50	25									
C	C1B Construction Management	100	25	50	25										
	C1C Project Support	60	10	40	10										
	D Management Reserve	25	5	10	5	5									
E	Contingency (DOE-Held)	78	5	5	5	6	6	6	6	6	6	6	7	7	7
<b>Total Project Costs (Escalated)</b>		<b>11,193</b>	<b>222</b>	<b>1,760</b>	<b>3,800</b>	<b>1,646</b>	<b>1,119</b>	<b>1,222</b>	<b>1,266</b>	<b>1,299</b>	<b>1,326</b>	<b>1,366</b>	<b>1,399</b>	<b>1,436</b>	<b>1,466</b>
		<b>Annual</b>													
F	Operations (LOE)	250			269	277	284	291	299	307	315	323	331	340	349
G	Security (LOE)	100		105	108	111	114	117	120	123	126	129	132	136	139
H	Infrastructure (LOE)	50		52	54	55	57	58	60	61	63				
I	Maintenance (LOE)	100		105	108	111	114	117	120	123	126	129	132	136	139
J	Transition (LOE)	50										65	66	68	70
K	Decontamination (LOE)	50									63	65	66	68	70
L	Decommissioning (LOE)	50									63	65	66	68	70
M	Demolition (LOE)	500													
<b>Total Operations (Escalated)</b>		<b>7,693</b>	<b>-</b>	<b>262</b>	<b>538</b>	<b>554</b>	<b>568</b>	<b>583</b>	<b>598</b>	<b>613</b>	<b>755</b>	<b>775</b>	<b>795</b>	<b>816</b>	<b>837</b>
<b>Total Life-Cycle Costs (Escalated)</b>		<b>18,886</b>	<b>222</b>	<b>2,022</b>	<b>4,339</b>	<b>2,200</b>	<b>687</b>	<b>705</b>	<b>723</b>	<b>742</b>	<b>887</b>	<b>910</b>	<b>934</b>	<b>958</b>	<b>983</b>

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Step 2 - Determine appropriate discount rates to be used. If Escalation is included in the Cost Estimate Summary, as in this example, use Nominal Discount Rates established by OMB. The following information may also be found in OMB A-94, and is updated bi-annually.

Nominal Discount Rates. A forecast of nominal or market interest rates for 2003 based on the economic assumptions from the 2004 Budget are presented below. These nominal rates are to be used for discounting nominal flows, which are often encountered in lease-purchase analysis.

Nominal Interest Rates on Treasury Notes and  
Bonds of Specified Maturities (in percent)

<b>3-Year</b>	<b>5-Year</b>	<b>7-Year</b>	<b>10-Year</b>	<b>30-Year</b>
<b>3.1</b>	<b>3.6</b>	<b>3.9</b>	<b>4.2</b>	<b>5.1</b>

Real Discount Rates. A forecast of real interest rates from which the inflation premium has been removed and based on the economic assumptions from the 2004 Budget are presented below. These real rates are to be used for discounting real (constant-dollar) flows, as is often required in cost-effectiveness analysis.

Real Interest Rates on Treasury Notes and  
Bonds of Specified Maturities (in percent)

<b>3-Year</b>	<b>5-Year</b>	<b>7-Year</b>	<b>10-Year</b>	<b>30-Year</b>
<b>1.6</b>	<b>1.9</b>	<b>2.2</b>	<b>2.5</b>	<b>3.2</b>

Analyses of programs with terms different from those presented above may use a linear interpolation. For example, a four-year project can be evaluated with a rate equal to the average of the three-year and five-year rates. Programs with durations longer than 30 years may use the 30-year interest rate.

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Step 3 - Calculate Present Worth of each alternative, using the Discount factor calculated as:

$$1/(1 + i)^t$$

where i is the discount rate and t is the year. For this example, a nominal discount rate is calculated for an ~15 year project, to be ~4.4%. Discount Factors are calculated in Table 8-18

Table 8-18

Example

Discount Rate Application, Discount Factor Calculation

FY	Year	Disc Rate	Disc Factor
2003	1	0.044	0.9579
2004	2	0.044	0.9175
2005	3	0.044	0.8788
2006	4	0.044	0.8418
2007	5	0.044	0.8063
2008	6	0.044	0.7723
2009	7	0.044	0.7398
2010	8	0.044	0.7086
2011	9	0.044	0.6787
2012	10	0.044	0.6501
2013	11	0.044	0.6227
2014	12	0.044	0.5965
2015	13	0.044	0.5713
2016	14	0.044	0.5473
2017	15	0.044	0.5242

Step 3 - Calculate Present Worth of Base Case and each Alternative Case. Tables 8-19 and 8-20 are examples of these tables.

# DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Table 8-19

Example

Cost Estimate Summary, including Present Worth, Base Case

			FY Funding														
	Activity	TPC	03	04	05	06	07	08	09	10	11	12	13	14	15		
A1A	Preliminary Design	103	103														
A1B	Definitive Design	207	207														
A1C	Design during Construction	109		37	37	36											
B2A	Equipment Procurement (General Services)	220			110	110											
B2B	Equipment Procurement (Long-Lead, GFE)	2,623	2000	623													
B2C	Facility Construction	6,597		1500	3597	1500											
C1A	Project Management	534	75	175	175	109											
C1B	Construction Management	267	25	100	100	42											
C1C	Project Support	267	25	100	100	42											
D	Management Reserve	180	25	75	75	5											
E	Contingency (DOE-Held)	86	10	25	25	26											
Total Project Costs (Escalated)		11,193	2,470	2,635	4,219	1,870	-	-	-	-	-	-	-	-	-		
Annual																	
F	Operations (LOE)	250			269	277	284	291	299	307	315	323	331	340	349		
G	Security (LOE)	100		105	108	111	114	117	120	123	126	129	132	136	139		
H	Infrastructure (LOE)	50		52	54	55	57	58	60	61	63						
I	Maintenance (LOE)	100		105	108	111	114	117	120	123	126	129	132	136	139		
J	Transition (LOE)	50										65	66	68	70		
K	Decontamination (LOE)	50									63	65	66	68	70		
L	Decommissioning (LOE)	50									63	65	66	68	70		
M	Demolition (LOE)	500										646	662	680	697		
Total Operations (Escalated)		10,378	-	262	538	554	568	583	598	613	755	1,420	1,457	1,495	1,534		
Total Life-Cycle Costs (Escalated)		21,571	2,470	2,897	4,757	2,424	568	583	598	613	755	1,420	1,457	1,495	1,534		
			0.9579	0.9175	0.8788	0.8418	0.8063	0.7723	0.7398	0.7066	0.6787	0.6501	0.6227	0.5965	0.5713		
Discounted Costs (PW)		17,142	2,366	2,658	4,181	2,040	458	450	442	435	513	923	908	892	877		

# DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Table 8-20

Example

Cost Estimate Summary, including Present Worth, Alternative Case

Activity	TPC	03	04	05	06	07	08	09	10	11	12	13	14	15
A Design during Construction / Renovation	50	50												
B2A Procurement / Lease Facility	1,560	102	105	108	111	114	117	120	123	126	129	132	136	139
B2C Facility Construction / Renovation	6,597		1500	3597	1500									
C1A Project Management	150	25	50	50	25									
C1B Construction Management	100	25	50	25										
C1C Project Support	60	10	40	10										
D Management Reserve	25	5	10	5	5									
E Contingency (DOE-Held)	78	5	5	5	6	6	6	6	6	6	6	7	7	7
<b>Total Project Costs (Escalated)</b>	<b>11,193</b>	<b>222</b>	<b>1,760</b>	<b>3,800</b>	<b>1,646</b>	<b>119</b>	<b>122</b>	<b>126</b>	<b>129</b>	<b>132</b>	<b>136</b>	<b>139</b>	<b>143</b>	<b>146</b>
<b>Annual</b>														
F Operations (LOE)	250			269	277	284	291	299	307	315	323	331	340	349
G Security (LOE)	100		105	108	111	114	117	120	123	126	129	132	136	139
H Infrastructure (LOE)	50		52	54	55	57	58	60	61	63				
I Maintenance (LOE)	100		105	108	111	114	117	120	123	126	129	132	136	139
J Transition (LOE)	50										65	66	68	70
K Decontamination (LOE)	50									63	65	66	68	70
L Decommissioning (LOE)	50									63	65	66	68	70
M Demolition (LOE)	500													
<b>Total Operations (Escalated)</b>	<b>7,693</b>	<b>-</b>	<b>262</b>	<b>538</b>	<b>554</b>	<b>568</b>	<b>583</b>	<b>598</b>	<b>613</b>	<b>755</b>	<b>775</b>	<b>795</b>	<b>816</b>	<b>837</b>
<b>Total Life-Cycle Costs (Escalated)</b>	<b>18,886</b>	<b>222</b>	<b>2,022</b>	<b>4,339</b>	<b>2,200</b>	<b>687</b>	<b>705</b>	<b>723</b>	<b>742</b>	<b>887</b>	<b>910</b>	<b>934</b>	<b>958</b>	<b>983</b>
		0.9579	0.9175	0.8788	0.8418	0.8063	0.7723	0.7398	0.7086	0.6787	0.6501	0.6227	0.5965	0.5713
<b>Discounted Costs (PW)</b>	<b>12,801</b>	<b>213</b>	<b>1,855</b>	<b>3,813</b>	<b>1,852</b>	<b>554</b>	<b>545</b>	<b>535</b>	<b>526</b>	<b>602</b>	<b>592</b>	<b>582</b>	<b>572</b>	<b>562</b>

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Step 4 - Compare all alternatives and determine the most cost-effective alternative. The lowest PW is the preferred alternative, from an economic perspective. Table 8-21 shows an example Summary of this PW comparison and clearly shows the most cost-effective alternative.

Table 8-21

Example

Summary of Base Case and Alternative with Discounted Costs, or PW

Activity FY	Base Case	Alt Case
03	2,366	213
04	2,658	1,855
05	4,181	3,813
06	2,040	1,852
07	458	554
08	450	545
09	442	535
10	435	526
11	513	602
12	923	592
13	908	582
14	892	572
15	877	562
PW	17,142	12,801

**Section 8.4 - Use of Activity-Based Costing (ABC) and Level-of-Effort (LOE) Estimating** 

Example of an ABC Estimate

Examples of an Activity-Based Cost (ABC) and Level of Effort (LOE) Estimates are being developed and will be included here.

The following is an example of an Activity-Based Cost Estimate.

In Table 8-22, WBS Element 8.4.1 represents installation of a 5 HP motor, in a pump house, for a roll-up door, in a secure area of a DOE site, in contaminated conditions (requiring PPE). This example illustrates the complexity of establishing ABC's for some, otherwise normal, activities. A few notes about this example:

- Labor Rate includes an average composite (including a foreman, two electricians, and a laborer), including fringes benefits and labor burden. Material Costs include taxes and shipping costs.
- Material Costs include taxes and shipping costs.
- Equipment Costs, if included, would include the hourly / quantified cost of the equipment, fuel, and maintenance.
- Subcontract Costs, if included, would also include the subcontractor's overheads and profit.
- Source codes may be used to represent where backup information was obtained (i.e. a database, vendor quote, etc.)

Table 8-22

Example

## Activity-Base Cost Estimate

WBS / COA Element	Activity	Qty	UOM	Source Code	Labor- Hours per UOM	Total Labor Hours	Labor \$/Hour	Total Labor \$	Mat \$/UOM	Total Mat \$	Equip \$/UOM	Total Equip \$	Sub \$/UOM	Total Sub \$	Total
8.4.1.1	Electric Motor, 5 HP	3	EA	M	2.000	6	32.00	192	500.00	1,500	-	-	-	-	1,692
8.4.1.2	Wiring	600	LF	M	0.050	30	32.00	960	0.50	300	-	-	-	-	1,260
8.4.1.3	Conduit	600	LF	M	0.100	60	32.00	1,920	2.50	1,500	-	-	-	-	3,420
8.4.1.4	Terminations	6	EA	M	0.500	3	32.00	96	5.00	30	-	-	-	-	126
8.4.1.5	Small Tools and Consumables	25	%	B						833					833
8.4.1.6	Productivity adjustment for Contaminated Conditions	25	%	B		25	32.00	792							792
8.4.1.7	pPE	1	LS	B						200					200
8.4.1.8	Productivity adjustment for Security Restrictions	25	%	B		25	32.00	792							792
8.4.1	Electric Motor Installation (Summary of WBS Element 8.4.1)	3	EA			149		4,752		4,363		-		-	9,115

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

From this example, summaries may be helpful in establishing or analyzing Unit Cost information. Given the above circumstances, the information provided in Table 8-23, is a summary.

Table 8-23

### Example

WBS / COA Element	Activity	Qty	UOM	Source Code	Labor-Hours per UOM	Total Labor Hours	Labor \$/Hour	Total Labor	Mat \$/UOM	Total Mat	Equip \$/UOM	Total Equip	Sub \$/UOM	Total Sub	Total
	Electric Motor Installation (Summary of WBS Element)	3	EA			149		4,752		4,363		-		-	9,115
	Electric Motor Installation (Summary of WBS Element, without Productivity Adjustments and Consumables)	3	EA			99		3,168		3,330		-		-	6,498
	Electric Motor Installation (Unit Summary of WBS Element, including Productivity Adjustments and Consumables)		EA	S		50		1,584		1,454		-		-	3,038
	Electric Motor Installation (Unit Summary of WBS Element, without Productivity Adjustments and Consumables)		EA	S1		33		1,056		1,110		-		-	2,166

### ABC Estimate Summary, Analysis

As this project data is tracked and analyzed, it may then be recorded in a database of historical cost information.

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

### LOE Cost Estimate

Similar to ABC Estimates, LOE estimates should represent some scope of work. LOE estimates have two contexts: 1) where there is not much known about a particular thing to be installed or an activity, or 2) where the productivity and costs of an activity are carried for several time periods at a similar rate (i.e. the costs of operations, such as x operators, for y amount of time). In many cases, LOE estimates are performed simply due to lack of time to prepare an estimate. LOE estimates are most appropriate for parts of a project, where there is little empirical data to support things such as material unit costs, labor productivity, or equipment usage in installation. Determining LOE, may also rely on input from the project team, to establish approximate scope, costs, and schedule to be attributed to the particular WBS or COA.

The following Table 8-24 is an example of an LOE estimate:

Table 8-24

### Example

### LOE Estimate

WBS / COA Element	Activity	Qty	UOM	Source Code	Labor- Hours per UOM	Total Labor Hours	Labor \$/Hour	Total Labor	Mat \$/UOM	Total Mat	Equip \$/UOM	Total Equip	Sub \$/UOM	Total Sub	Total
8.4.1.1	Special Electric Motors	1	LS	G	100.000	100	32.00	3,200	1,000.00	1,000	-	-	-	-	4,200
8.4.1.2	Wiring	1	LS	G	50.000	50	32.00	1,600	500.00	500	-	-	-	-	2,100
8.4.1.3	Conduit	1	LS	G	100.000	100	32.00	3,200	1,000.00	1,000	-	-	-	-	4,200
8.4.1.4	Terminations	1	LS	G	50.000	50	32.00	1,600	50.00	50	-	-	-	-	1,650
8.4.1.5	Small Tools and Consumables	25	%	B						638					638
8.4.1.6	Productivity adjustment for Contaminated Conditions	25	%	B		75	32.00	2,400							2,400
8.4.1.7	PPE	1	LS	B						200					200
8.4.1.8	Productivity adjustment for Security Restrictions	25	%	B		75	32.00	2,400							2,400
8.4.1	Special Electric Motor Installation (Summary of WBS Element 8.4.1)	1	LS			450	####			3,388			-	-	17,788

Variations on this LOE are many and should be considered carefully before using. For instance, if you have an LOE for motor installation, it may be questionable why it not include the circumstances surrounding its installation (contamination and security productivity adjustments).

**Chapter 9 – Appendices** 

9.1 – PARS Project Reporting Requirements and Procedures

9.2 – Review Criteria

9.3 - Cost Estimate Review Checklist

9.4 - Construction COA (Uniformat II)

9.5 - Alternative Construction COA (Masterformat)

9.6 - Environmental Management COA (ECES)

9.7 - TPC and TEC Guidance and Clarification

9.8 - Capital Asset Plan (Exhibit 300) OMB A-11

9.9 - AACE Recommended Practice No. 17R-97

**APPENDIX 9.1 - PARS PROJECT REPORTING REQUIREMENTS AND PROCEDURES**

1. All projects with subject to DOE Order 413.3, Program and Project Management for the Acquisition of Capital Assets, that have a Total Project Cost of \$5 million or more must provide monthly project status using PARS.
2. No later than October 30, 2001, each Major System federal project or program manager will verify and update the data in PARS and will begin to immediately provide current status information updated monthly.
3. All projects that have implemented an Earned Value measure capability will enter the historical earned value data; however, no historical narrative is necessary, except as it is necessary to explain significant perturbations.
4. No later than December 31, 2001, project or program managers will verify and update the data for all non-major systems. This update must include earned value data, where it is available.
5. No later than 14 days following receipt of the contractor's progress reports for each month, the program or project manager will enter the required summary data into PARS.
6. Where the data for a specific field does not exist, the field may be left blank.
7. Where elements of information are not available, because it does not exist, the narrative should contain a statement that the data does exist to ensure that users recognize that you are reporting the available data. When the data does become available you must update the record to incorporate the actual data.
8. If you need help with a system issue contact PARS Help. If you have a question regarding a data element please contact the following individuals:

David Treacy

Rebecca Montoya

Department of Energy

Department of Energy

CR-80

CR-80

1000 Independence Ave., SW

1000 Independence Ave., SW

Washington, D.C. 20585

Washington, D.C. 20585

(202) 586-3151

(202) 586-4633

David.Treacy@hq.doe.gov

Becky.Montoya@hq.doe.gov

Please do not submit your completed New User Account Request Form to these individuals since they will not be establishing new user accounts.

9. In many cases, a project record will have already been created. If you have determined your project is already entered, you must verify the existing data and you must enter the missing or incorrect data. Funding and budget data are stored in thousands. Please verify that the funding data is correct.

The information for each record consists of three types of data.

1. Identity or profile data. This is data that is entered one time and is used to identify the project, points of contact and other identifying information.
2. Event data. These are data elements, which are associated with the lifecycle of a project, such as decision data, milestones, budget, funding, and other information, which changes infrequently.
3. Status and performance data. This is information which should be available monthly from the contractor's project control system (and other sources) provides information on the progress and overall status of a project. Nearly all static data elements will be found in the project execution plan and the project data sheet. In general, negative replies are not required. Where no data exist for a specific element, leave the field blank. Where a field is not applicable, no entry is required.

Creating a record involves entering both identity and event data. Most of this data can be obtained from the Project Execution Plan, the Project Data Sheet, or other similar documentation used in planning the project.

**APPENDIX 9.2 - REVIEW CRITERIA** 

These criteria should be considered a minimum. All criteria must be addressed to be complete and if all criteria are reasonably addressed, then the estimates represented should be considered reasonable.

1. Escalation. Escalation should be included appropriately and the rates applied should be based on those provided by DOE or other documented basis.

Escalation is the provision in a cost estimate for increases in the cost of equipment, material, labor, etc. due to continuing price changes over time. Escalation is used to estimate the future cost of a project or to bring historical costs to the present.

Consideration of escalation is most appropriate for long term projects, most Type 5 - Rough Order of Magnitude, and some Type 3 – Preliminary / Budgetary and Type 1 – Definitive Cost Estimate types. Escalation is least appropriate for nearer term projects, including some budgetary and most definitive estimate types.

2. Contingency. Allowances / Management Reserve / Contingency, including Schedule Contingency should be included appropriately and should be based on apparent project risks or a projects risk analysis, to the extent possible, but in any event should have a documented basis. Contingency / MR may be calculated using a deterministic or probabilistic approach, but the method employed should be appropriate and documented.

Contingency is an amount included in an estimate to cover costs that may result from incomplete design, unforeseen and unpredictable conditions, or uncertainties. Contingency should also be commensurate with Risk - a factor, element, constraint, or course of action on a project that introduces an uncertainty of outcome and the possibility of technical deficiencies, inadequate performance, schedule delays, or cost overruns that could impact a Departmental mission. In the evaluation of project risk, the potential impact and the probability of occurrence must be considered.

Contingency is most significant and appropriate for long-term projects, most order of magnitude and budgetary estimate types, whose size and complexity are significant. Contingency is less significant and less appropriate for nearer term projects whose size and complexity are less significant.

3. Indirect and Overhead Rates. Any rates applied as percentages, including Indirect and Overhead Rates, should be documented and referenced in the basis of estimate. Indirect Rates should be defined for consistent application and be appropriate for a given project. Overhead Rates should also be defined and appropriately applied.

4. Qualified Cost Estimators. Normally, Cost Estimators / Cost Engineers are an integral part of an Integrated Project Team. Cost Estimates should be performed and documented by professionals trained in the use of cost estimating tools, methodology, and all aspects of estimating, project control, and project management.

5. Work Breakdown Structure (WBS). A WBS should be consistent between the technical definition, the cost estimate, and the schedule. The use of a common WBS should be considered for consistency between projects within a program WBS. Use of a standardized Code of Accounts is also recommended.

6. Scope of Work. A projects Scope of Work should be commensurate with the phase of planning, project size, and complexity and should be activity based to the extent practical.

7. Level of Effort. Level of Effort activities included in a cost estimate should be traceable to a scope of work and should be commensurate with the phase of planning, project size, and complexity. Level of Effort activities may be appropriate for certain aspects of a project or program.

8. Methods. Cost Estimating Methods employed should be appropriate based on Estimate Type, Purpose, available technical information, time constraints, and should be commensurate with the phase of planning, project size, and complexity. The chosen methodologies should facilitate systematic Cost Estimate duplication or verification.

9. Cost Estimate Documentation. Cost Estimate Documentation should be easily discernable, traceable, and consistently used. As a matter of GREAT relative importance, Cost Estimate Documentation should be very thorough (i.e. provided to the extent possible). In most cases, documentation should be specific for a given project (or sub-project) and should be centrally maintained to assure Technical / Cost / Schedule consistency, Management Focus, and ease of reference.

10. Cost Estimate Updates. Cost Estimate Updates should be considered and included as appropriate to reflect new information, given a project's phase of planning and/or execution. Whether considering information contained in a previous estimate supporting a CD, a potential Change to a project / contract / budget, or a Value Engineering study, previous versions of Cost Estimates are appropriate to consider, but should only be considered appropriately.

11. Life-Cycle Costs. Life-Cycle Costs should be included in Life-Cycle Cost Estimates, as appropriate. Life-cycle cost estimates are most pertinent during decision-making phases of a project's life, when life cycle cost analyses (comparison of life cycle cost estimates, or VE Studies) are performed, but should be considered throughout a project's life.

Life Cycle Costs should include: Start-up Costs; Operating Costs; Manufacturing Costs; Machining Costs; Research and Development Costs; Engineering, Design, and Inspection Costs; Decommissioning Costs; and Direct Costs, Indirect Costs, Overheads, Fee, Contingency, and Escalation.

## **APPENDIX 9.3 - COST ESTIMATE REVIEW CHECKLIST**

WBS Number: \_\_\_\_\_ Review Date: \_\_\_\_\_

Program Name: \_\_\_\_\_ Review Location: \_\_\_\_\_

Reviewer's Names and  
Organizations: \_\_\_\_\_

Program Location: \_\_\_\_\_ Program Manager: \_\_\_\_\_

	Yes	No	NA	Comments
<b>A. Background Data and Conditions</b>				
! Has a complete Technical Scope Documentation, including the following elements, been prepared for the estimate.  ____ Description of the work to be performed; ____ End condition or end product of work; ____ Performance criteria and requirements; ____ Discrete tasks and deliverables; ____ Resource requirements; ____ Sequence of events and discrete milestones; ____ Performance methodology and task plans; and ____ Work not included in the scope.				
! Are the major assumptions used in developing the technical scope for the program clearly identified and justified in the technical Scope Documentation?				
! Are Technical Logic Diagrams and/or Process Flow Diagrams, where appropriate, included in the Technical Scope Documentation?				
<b>A. Background Data and Conditions (continued)</b>				
! Have Milestone Log and Milestone Description Sheets been developed that contain descriptions of each milestone associated with the program?				
! Is the rationale used to develop task descriptions and logic diagrams, milestones, and resource requirements explained in the Technical Scope documentation?				
! Does the Technical Scope Documentation for the estimate include specific activities associated with the work to be performed and activity-based resource descriptions?				

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

	Yes	No	NA	Comments
! Has an Activity Dictionary been developed for the program, including detailed descriptions of activities associated with the work to be performed?				
! Does the Technical Scope Documentation for the estimate include descriptions of support activities (e.g., occupational health and safety, quality assurance, security, etc.) associated with the work to be performed?				
! Are back-up documentation (such as production or waste management plans, process technical and engineering data, process output or throughput projections, and historical operating data) available for review, used in scope development, and referenced in the Technical Scope Documentation?				
! Is the technical scope for the estimate consistent with the site mission, regulatory drivers and constraints, and internal and external drivers and constraints (e.g., consent orders, permit conditions, regulations, orders, etc.) identified during the planning process?				
<b>B. Cost Estimate</b>				
! Are historical cost data included in the cost estimate for the activities for which costs have been estimated?				
! Do the historical data used to prepare the cost estimate show each activity costed and show the cost of conducting that activity, broken down into the quantity associated with each activity and the labor cost, material cost, and other costs incurred per unit quantity?				
! Are indirect, overhead, or other costs that are distributed among activities included in the cost estimate clearly and individually identified?				
<b>B. Cost Estimate (continued)</b>				
! Are direct costs that are associated with individual activities included in the cost estimate clearly and individually identified?				
! Are the indirect labor costs used throughout the cost estimate approved and audited, and appropriately and correctly identified?				
! Are unit labor costs broken down into direct costs				

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

	Yes	No	NA	Comments
and indirect costs?				
! Has the cost estimate been updated in a timely manner in response to relevant changes in its basis, background data, or assumptions?				
! Are an appropriate Change Control Document and an Estimate Development History attached to the cost estimate?				
! Does the Estimate Development History include an itemized and chronological list of the changes made to the cost estimate since initiation of its preparation, and the rationale for each change?				
! Is an Estimate Purpose Statement included in the cost estimate? Does the Estimate Purpose Statement clearly describe the purpose of the estimate?				
! Is the scope of work for the program for which the cost estimate was prepared adequately described and consistent with the Planning and Technical Scope Documentation developed through the planning and scoping process?				
! Has an estimate-specific Work Breakdown Structure been developed for the program?				
! Does the estimate-specific WBS organize the work to be performed in a logical and consistent manner?				
! Is the cost estimate activity-based?				
! Are activities, quantities, and unit costs associated with the work to be performed clearly identified and defined in the cost estimate?				
! Has an estimate-specific Activity Dictionary been developed for the program?				
! Does the estimate-specific Activity Dictionary describe all activities associated with the work to be performed in a logical and consistent manner?				
<b>B. Cost Estimate (continued)</b>				
! Does the estimate-specific Activity Dictionary describe all activities associated with the work to be performed in a logical and consistent manner?				
! Are the assumptions and exclusions upon which the cost estimate is based clearly identified and defined in the cost estimate?				

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

	Yes	No	NA	Comments
<p>! Are time and cost assumptions and cost elements associated with each activity clearly identified, defined, and documented in the cost estimate? Cost elements for program activities include:</p> <ul style="list-style-type: none"> <li>- quantity;</li> <li>- unit of measure;</li> <li>- labor hours per unit;</li> <li>- total labor hours;</li> <li>- material usage rate per unit;</li> <li>- total material cost;</li> <li>- equipment usage rate per unit;</li> <li>- total equipment cost;</li> <li>- overhead rate; and</li> <li>- total overhead allocated cost.</li> </ul>				
! Are significant findings of the cost estimate preparer identified during preparation of the cost estimate included in the cost estimate?				
! Have estimate factors been used to adjust the cost estimate? If so, have they been adequately documented and appropriately applied?				
! Have escalation factors been used to escalate the cost estimate?				
! If escalation factors provided by DOE Headquarters have been used, have they been adequately documented and appropriately applied?				
! If escalation rates other than the provided by DOE Headquarters have been used, have they been audited and approved by DOE Headquarters?				
! Are indirect rates used in the cost estimate adequately documented and appropriately applied?				
<b>B. Cost Estimate (continued)</b>				
! Are Estimate Summary and Detailed Reports included in the cost estimate?				
! Do the Estimate Summary and Detailed Reports provide cost totals for each activity in the Activity Dictionary and for each cost element in the cost estimate?				
! Is a schedule included with the cost estimate?				
! Are activities included in the schedule consistent with those included in the Technical Scope Documentation, Activity				

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

	Yes	No	NA	Comments
Dictionary, and cost estimate?				
! Are milestones and deliverables included in the schedule consistent with those included in the Technical Scope Documentation and cost estimate?				
! Is an Estimate Criteria Document included in the cost estimate?				
! Does the Estimate Criteria Document clearly describe the methodology by which the cost estimate was developed?				
! Does the Estimate Criteria Document clearly describe the basis for the cost estimate and the assumptions made in developing the cost estimate?				
! Has the entire cost estimate package (including technical scope and schedule) for the program been subject to peer review by individuals who were <u>not</u> involved in preparation of the cost estimate, but who are qualified to have prepared the cost estimate themselves.				
<b>B.Cost Estimate (continued)</b>  ! Has the peer review considered the elements listed below?  - the basis for the assumptions made in developing the cost estimate;  - consistency of assumptions made in the cost estimate, technical scope, and schedule;  - consistency of definitions of activities in the cost estimate, technical scope, and schedule;  - consistency of durations of activities in the cost estimate, technical scope, and schedule;  - documentation of productivity and unit cost data for program activities; and  - appropriate use of indirect rates, escalation factors, and other factors used by the cost estimate preparer.				
! Have the findings and recommendations of the peer review been documented in a Peer Review Document?				
! Is the Peer Review Document included with the cost estimate documentation?				

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

---

	Yes	No	NA	Comments
! Have the findings and recommendations of the peer review been addressed in revisions to the cost estimate?				
! Are activities included in the schedule consistent with those included in the Technical Scope Documentation, Activity Dictionary, and cost estimate?				

**Appendix 9.4 Construction COA - Uniformalt II** 

ASTM's "Standard Classification for Building Elements and Related Sitework - UNIFORMAT II" (E 1557-96 ) is a national standard and is used throughout the commercial construction industry. Use of the Uniformalt II has not been made a requirement within DOE, although its use on projects is recommended. Details and background of the Uniformalt II may be found at <http://www.uniformalt.com/background.html> .

Level 1 Major Group Elements (A-G)

Level 2 Group Elements

Level 3 Individual Elements

- |   |  |
|---|--|
| <p>A. SUBSTRUCTURE</p> <ul style="list-style-type: none"><li>A10 Foundations<ul style="list-style-type: none"><li>A1010 Standard Foundations</li><li>A1020 Special Foundations</li><li>A1030 Slab on Grade</li></ul></li><li>A20 Basement Construction<ul style="list-style-type: none"><li>A2010 Basement Excavation</li><li>A2020 Basement Walls</li></ul></li></ul> <p>B. SHELL</p> <ul style="list-style-type: none"><li>B10 Superstructure<ul style="list-style-type: none"><li>B1010 Floor Construction</li><li>B1020 Roof Construction</li></ul></li><li>B20 Exterior Closure<ul style="list-style-type: none"><li>B2010 Exterior Walls</li><li>B2020 Exterior Windows / Exterior Doors</li></ul></li><li>B30 Roofing<ul style="list-style-type: none"><li>B3010 Roof Coverings</li><li>B3020 Roof Openings</li></ul></li></ul> <p>C. INTERIORS</p> <ul style="list-style-type: none"><li>C10 Interior Construction<ul style="list-style-type: none"><li>C1010 Partitions</li><li>C1020 Interior Doors</li><li>C1030 Specialties</li></ul></li></ul> | <ul style="list-style-type: none"><li>C20 Staircases<ul style="list-style-type: none"><li>C2010 Stair Construction</li><li>C2020 Stair Finishes</li></ul></li><li>C30 Interior Finishes<ul style="list-style-type: none"><li>C3010 Wall Finishes</li><li>C3020 Floor Finishes</li><li>C3030 Ceiling Finishes</li></ul></li></ul> <p>D. SERVICES</p> <ul style="list-style-type: none"><li>D10 Conveying Systems<ul style="list-style-type: none"><li>D1010 Elevators</li><li>D1020 Escalators &amp; Moving Walks</li><li>D1030 Material Handling Systems</li></ul></li><li>D20 Plumbing<ul style="list-style-type: none"><li>D2010 Plumbing Fixtures</li><li>D2020 Domestic Water Distribution</li><li>D2030 Sanitary Waste</li><li>D2040 Rain Water Drainage</li><li>D2050 Special Plumbing Systems</li></ul></li><li>D30 HVAC<ul style="list-style-type: none"><li>D3010 Energy Supply</li><li>D3020 Heat Generating Systems</li><li>D3030 Cooling Generating Systems</li><li>D3040 Distribution Systems</li><li>D3050 Terminal &amp; Package Units</li><li>D3060 Controls &amp; Instrumentation</li></ul></li></ul> |
|---|--|

D3070 Special HVAC Systems & Equipment	G. BUILDING SITEWORK
D3080 Systems Testing & Balancing	G10 Site Preparation
	G1010 Site Clearing
D40 Fire Protection	G1020 Site Demolition & Relocations
D4010 Fire Protection Sprinkler Systems	G1030 Site Earthwork
D4020 Stand-Pipe & Hose Systems	G1040 Hazardous Waste
D4030 Fire Protection Specialties	Remediation
D4040 Special Electrical Systems	
	G20 Site Improvements
D50 Electrical	G2010 Roadways
D5010 Electrical Service & Distribution	G2020 Parking Lots
D5020 Lighting & Branch Wiring	G2030 Pedestrian Paving
D5030 Communication & Security Systems	G2040 Site Development
D5040 Special Electrical Systems	G2050 Landscaping
	G4010 Electrical Distribution
E. EQUIPMENT & FURNISHINGS	G4020 Exterior Lighting
E10 Equipment	G4030 Exterior Communications & Security
E1010 Commercial Equipment	G4040 Other Electrical Utilities
E1020 Institutional Equipment	
E1030 Vehicular Equipment	G30 Site Civil / Mechanical Utilities
E1040 Other Equipment	G3010 Water Supply & Distribution Systems
	G3020 Sanitary Sewer Systems
E20 Furnishings	G3030 Storm Sewer Systems
E2010 Fixed Furnishings	G3040 Heating Distribution
E2020 Movable Furnishings	G3050 Cooling Distribution
	G3060 Fuel Distribution
F. SPECIAL CONSTRUCTION & DEMOLITION	G3070 Other Civil / Mechanical Utilities
F10 Special Construction	
F1010 Special Structures	G40 Site Electrical Utilities
F1020 Integrated Construction	G5020 Other Site Systems & Equipment
F1030 Special Construction Systems	
F1040 Special Facilities	
F1050 Special Controls & Instrumentation	G50 Other Site Construction
	G5010 Service Tunnels
F20 Selective Building Demolition	G5020 Other Site Systems & Equipment
F2010 Building Elements Demolition	
F2020 Hazardous Components Abatement	

**Appendix 9.5 – Alternative Construction COA (Masterformat)** 

The 16 Divisions of CSI's Masterformat include typical Construction Products and Activities, although care should be taken to also include Design, Project Management, Construction Management, Indirect Costs, Overhead Costs, Profit / Fee, Contingency, and Escalation.

CSI's Masterformat is not an ASTM Standard, although it has been recognized for decades as the primary tool for standardizing the Construction industry. As such, it is still widely used through out the DOE and should be recognized as an acceptable standard.

Use of CSI's Masterformat has not been made a requirement within DOE, although its use on construction projects is recommended, as an alternative to the Uniformat II. Details and background of the Masterformat may be found at <http://www.csinet.org/technic/mflite.htm> .

**Construction Products and Activities**

- Division 1 — General Requirements
- Division 2 — Site Construction
- Division 3 — Concrete
- Division 4 — Masonry
- Division 5 — Metals
- Division 6 — Wood and Plastics
- Division 7 — Thermal and Moisture Protection
- Division 8 — Doors and Windows
- Division 9 — Finishes
- Division 10 — Specialties
- Division 11 — Equipment
- Division 12 — Furnishing
- Division 13 — Special Construction
- Division 14 — Conveying Systems
- Division 15 — Mechanical
- Division 16 — Electrical

**Appendix 9.6 Environmental Management COA – The ECES** 

ASTM's "*Standard Classification for Life-Cycle Environmental Work Elements - Environmental Cost Element Structure*" (E 2150-01), also known as the ECES, is a national standard and is used throughout the commercial environmental industry.

The levels of the Environmental Cost Element Structure (ECES) include the 8 Project Phases (Level 1), 34 Major Elements (Level 2), and several hundred Detailed Elements (Level 3). These elements include Design, Project Management, Construction Management, Indirect Costs, Overhead Costs, Profit / Fee, Contingency, and Escalation.

Use of the ECES has not been made a requirement within DOE, although its use on EM projects is recommended. Details and background of the ECES may be found at <http://www.em.doe.gov/cost/eces.html> .

**Level 1 – Project Phases**

Phase 1 – Assessment

Phase 2 – Studies

Phase 3 – Design

Phase 4 – Construction

Phase 5 – Operations and Maintenance (O&M)

Phase 6 – Surveillance and Long-Term Maintenance (LTSM)

Phase 7 – Reserved

Phase 8 – Program Management, Support, and Infrastructure

**Level 2 – Major Elements**

.01 PROGRAM MANAGEMENT, SUPPORT & INFRASTRUCTURE (Optional - Installation/Complex Wide Activities)

.02 PROJECT MANAGEMENT & SUPPORT (Operable Unit/Solid Waste Management Unit)

.03 PREPARATION OF PLANS

.04 STUDIES/DESIGN & DOCUMENTATION

- .05 SITE WORK
- .06 SURVEILLANCE & MAINTENANCE
- .07 INVESTIGATIONS & MONITORING/SAMPLE COLLECTION
- .08 SAMPLE ANALYSIS
- .09 SAMPLE MANAGEMENT/DATA VALIDATION/DATA EVALUATION
- .10 TREATABILITY/RESEARCH & DEVELOPMENT
- .11 TREATMENT PLANT FACILITY/PROCESS
- .12 STORAGE FACILITY/PROCESS
- .13 DISPOSAL FACILITY/PROCESS
- .14 ORDNANCE & EXPLOSIVES REMOVAL & DESTRUCTION (CWM is in X.11 & X.20-X.30)
- .15 DRUMS/TANKS/STRUCTURES/MISC. & REMOVAL
- .16 AIR POLLUTION/GAS COLLECTION & CONTROL
- .17 SURFACE WATER/SEDIMENTS CONTAINMENT, COLLECTION, OR CONTROL
- .18 GROUNDWATER CONTAINMENT, COLLECTION, OR CONTROL
- .19 SOLIDS/SOILS CONTAINMENT (e.g., CAPPING/BARRIER) COLLECTION, OR CONTROL
- .20 LIQUIDS WASTE/SLUDGES (e.g., UST/AST) COLLECTION AND CONTAINMENT
- .21 IN SITU BIOLOGICAL TREATMENT
- .22 EX SITU BIOLOGICAL TREATMENT
- .23 IN SITU CHEMICAL TREATMENT
- .24 EX SITU CHEMICAL TREATMENT
- .25 IN SITU PHYSICAL TREATMENT
- .26 EX SITU PHYSICAL TREATMENT
- .27 IN SITU THERMAL TREATMENT
- .28 EX SITU THERMAL TREATMENT

- .29 IN SITU STABILIZATION/FIXATION/ENCAPSULATION
- .30 EX SITU STABILIZATION/FIXATION/ENCAPSULATION
- .31 FACILITY DECOMMISSIONING & DISMANTLEMENT
- .32 MATERIAL HANDLING/TRANSPORTATION
- .33 DISPOSAL - COMMERCIAL
- .34 AIR-EMISSION AND OFF-GAS TREATMENT
- .9X OTHER (Use Numbers 90-99)

**APPENDIX 9.7 – TEC/OPC/TPC (APB)**  
**Activities and Deliverables depicting TEC and OPC**

Activities / Deliverables	Expense / Operations	Capital		
		PED	TPC	
			OPC	TEC
<b>Prior to CD-0</b>				
Establish Project Team	x			
Establish Program/Project Planning Budget	x			
Develop Project Scope				
Identify Customer Expectations	x			
Identify Key Schedule Drivers	x			
Identify Funding Constraints	x			
Identify High-Level Functions and Requirements	x			
Identify Project-Level Interfaces	x			
Identify Capital & Life-Cycle Cost Drivers	x			
Develop Pre-Acquisition Design Schedule	x			
Develop Conceptual Design Schedule Range	x			
Develop Market Plan	x			
Develop Up-Front Conceptual Design Business Decision Estimate & Budgets	x			
Develop Pre-Acquisition Design Budget	x			
Establish Placeholder in Out-Year Budget	x			
Initiate Pre-Acquisition Planning and Design	x			
Assess Technology Maturity Phase Plan	x			
Submit CD-0 Package	x			
Develop Project-Level Functions and Requirements	x			
Identify Pre-Acquisition Risks	x			
Perform Alternative/Value Management Studies	x			
Identify Long-Lead or Special Procurement	x			
Establish Conceptual Design Budget & Schedule	x			
Develop Preliminary Design & Schedule Range	x			
Develop Preliminary/Final Design Range	x			
Develop TPC & Schedule Range	x			
Preliminary Environmental Strategy	x			
Identify Current & Next 2 FYs Funding Requirements	x			
Initiate PDS for Design	x			
Program Plan	x			
Mission Need Independent Project Review	x			
AS in the PASD	x			

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Activities / Deliverables	Expense / Operations	Capital		
		PED	TPC	
			OPC	TEC
PDS for Design with Special Procurement Disclosure	x			
Tech Task Request	x			
Technology Development Issues	x			
<b>Activities prior to CD-1</b>				
Perform Project & Detail Design Phase Technical and Programmatic Risk Analysis		x	x	
Develop System-Level Functions and Requirements		x	x	
Confirm Long-Lead Procurements		x	x	
Develop PEP for Preliminary Design		x	x	
Set Project Execution Strategy		x	x	
Perform Site Investigation & Alternatives		x	x	
Review Design Alternatives/perform VM		x	x	
Identify Project Codes, Standards, and Procedures		x	x	
Update Preliminary/Final Design Cost Estimate		x	x	
Develop Preliminary Design Phase Budget & Schedule		x	x	
Update TPC & Schedule Range		x	x	
Perform Safety & Operability Review		x	x	
Identify Current & 2 FYs Funding Requirements		x	x	
Acquisition Strategy		x	x	
Project Expectations Summary		x	x	
SOW for Design		x	x	
CA/EIS/Record of Decision		x	x	
Systems Engineering Mgmt Plan		x	x	
Conceptual Design Package		x	x	
Preliminary PEP		x	x	
Preliminary Hazard Analysis Report		x	x	
Preliminary Team Execution Plan		x	x	
RMP		x	x	
Preliminary Design Phase Budget and Schedule		x	x	
Verification of Mission Need		x	x	
CD-1 Package		x	x	
Updated TPC & Schedule Range		x	x	
Formal Value Management Plan		x	x	

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Activities / Deliverables	Expense / Operations	Capital		
		PED	TPC	
			OPC	TEC
<b>Prior to CD-2</b>				
Define Special Procurement		x	x	x
Develop, Validate, & Issue Phased Package, if Necessary		x	x	x
Finalize Permit Requirements		x	x	x
Finalize Team Execution Plan		x	x	x
Commit Critical Equipment		x	x	x
Initiate Pulse Surveys		x	x	x
Perform Process Hazards Review		x	x	x
Project Site Selection		x	x	x
Update PEP		x	x	x
Update Technical and Programmatic Risk Analysis		x	x	x
Perform Formal Value Management		x	x	x
Develop Baselines		x	x	x
Develop CD-2 Package		x	x	x
Define CD-3 Deliverables & Completion Criteria		x	x	x
Update Annual/Out-Year BA		x	x	x
Prepare PDS for Construction		x	x	x
Conduct EIR		x	x	x
Conduct ICR or Estimate		x	x	x
Review of Contractor Project Mgmt System		x	x	x
Preliminary Design Detailed Schedules		x	x	x
Issued for Design Source Documents		x	x	x
Assignment of Responsibilities Matrix		x	x	x
Performance Metrics		x	x	x
Staffing Plans		x	x	x
Tech Risk Analysis Report		x	x	x
Technology Development Output		x	x	x
Prelim Safety Analysis Report		x	x	x
EVMS certify		x	x	x
NEPA Documentation		x	x	x
<b>Prior to CD-3</b>				
Receive Critical Vendor Data			x	x
Finalize 3D Computer Aided Drafting and Design Setup			x	x
Complete Design Model			x	x
Conduct Technical Innovations			x	x

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

Activities / Deliverables	Expense / Operations	Capital		
		PED	TPC	
			OPC	TEC
Evaluation			X	X
Finalize Planning Drawings			X	X
Finalize Field Support Plan			X	X
Review Safety Action Plan			X	X
Perform Final Design Review			X	X
Equipment and Material Requisitions			X	X
Issue for Construction Design Documents			X	X
100% Definitive Estimate			X	X
Integrated Project Schedule and Sub-tier Schedules			X	X
Updated PEP & Performance Baseline			X	X
Final Design & Procurement Pkgs			X	X
Verification of Mission Need Budget & Congressional Authorization			X	X
Approved Safety Documentation			X	X
Execution Readiness Independent Review			X	X
Updated Construction PDS			X	X
<b>Activities prior to CD-4</b>				
Start Site Work				X
Complete Procurement of Materials and Equipment				X
Start Systems Completion				X
Initiate Document Closeout Process				X
Work off Punch Lists				X
Turnover & Startup Plan				X
Operating and Maintenance Manuals				X
Construction Completion				X
Startup Commissioning				X
Test Plan				X
Final Safety Analysis Report				X
Annual Updated				X
Construction PDS				X
<b>Activities after CD-4</b>				
Startup/Commissioning			X	
Verification of Testing			X	
Lessons Learned			X	
ORR & Acceptance Report			X	

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

---

Activities / Deliverables	Expense / Operations	Capital		
		PED	TPC	
			OPC	TEC
Approval for Acceptance			x	
As-Built Drawings			x	
Final Safety Report			x	
Project Completion Report			x	

# DOE Cost and Schedule Estimating Guide – DRAFT February 2003

## Appendix 9.8 Capital Asset Plan (Exhibit 300) OMB A-11, FY2003 Budget Submission, 4

PART I. A. SUMMARY OF PROJECT INFORMATION									
For detailed instructions on completing the capital asset plan please see A-11 details section 300 at <a href="http://www.whitehouse.gov/omb">www.whitehouse.gov/omb</a>									
Agency									
Bureau									
Account Title									
Account Identification Code									
Program Activity									
Name of Project									
Unique Project Identifier									
This project is ____ New or ____ Ongoing									
Project/Useful segment is funded: ____ Incrementally ____ Fully									
Did the Executive/Investment Review Committee approve funding for this project this year?	Yes		No						
Did the CFO review the cost goal?	Yes		No						
Did the Procurement Executive review the acquisition strategy?	Yes		No						
Is this project information technology (see Section 53.2 for a definition)?	Yes		No						
For information technology projects <i>only</i> . (The CIO must review)									
a. Is this Project a Financial Management System (see section 53.2 for a definition)?	Yes		No						
If so, does this project address a FFIA compliance area?	Yes		No						
If so, which compliance area?									
b. Does this project implement electronic transactions or recordkeeping?	Yes		No						
If so, is it included in your GPEA plan?	Yes		No						
c. Was a privacy impact assessment performed on this project?	Yes		No						
d. Does the security of this project meet the requirements of the Government Information Security Reform Act (GISRA)?	Yes		No						
e. Were any weaknesses identified for this project in the annual program review or independent evaluation?	Yes		No						
B. SUMMARY OF SPENDING FOR PROJECT STAGES									
(In Millions)									
	PY-1 and Earlier	PY	CY	BY	BY+1	BY+2	BY+3	BY+4 Beyond	Total
<b>Planning</b>									
Budget Authority									
Outlays									
<b>Full Acquisition</b>									
Budget Authority									
Outlays									
<b>Subtotal (planning and full acquisition) (DME)</b>									
Budget Authority									
Outlays									
<b>Maintenance (SS)</b>									
Budget Authority									
Outlays									
<b>Total all phases (DME plus SS)</b>									
Budget Authority									
Outlays									

### C. PROJECT DESCRIPTION

(briefly describe (less than 1/2 page) the general purpose of the project and the expected performance outcome at project completion)

### PART II: JUSTIFICATION AND OTHER INFORMATION

#### A. Justification

#### B. Program Management

Have you assigned a program manager and contracting officer to this project? If so, what are their names?

#### C. Acquisition Strategy

#### D. Alternatives Analysis and risk management

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

### E. Enterprise Architecture (IT Projects Only)

### F. Security and Privacy (IT projects only)

### G. Government Paperwork Elimination Act (GPEA) (IT projects only)

### PART III: COST, SCHEDULE, AND PERFORMANCE GOALS

### A. Performance Based Management System (PBMS): Which performance based management system will you use to monitor contract or project progress?

### B. Original baseline (OMB approved at project outset): Using the format of your selected PBMS, provide the following:

1. What are the cost and schedule goals for this segment or phase of this project? [i.e., what are the project milestones or events, when will each occur; and what is the estimated cost to accomplish each one]

2. What are the measurable performance benefits or goals for this segment or phase of this project? [what are the measurable performance improvements or efficiencies that you expect to achieve with this project?]

### C. Current baseline (applicable only if OMB approved the changes):

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

---

1. What are the cost and schedule goals for this segment or phase of the project?

2. What are the measurable performance benefits or goals for this segment or phase of this project?

**D. Actual Performance and Variance from OMB approved baseline:**

1. Actual cost and schedule performance. Using the information from your PMBS, explain:

- a. What work you planned (scheduled) to accomplish and how much you budgeted to complete the work.
- b. What you actually accomplished and how much you actually spent.

2. Cost and schedule variance. If either the actual work accomplished or costs incurred vary from your baseline goals by 10 percent or more, explain:

- a. The variance between planned and actual costs or planned and actual schedule, expressed as a percentage of the baseline goal.
- b. The reason for the variance.

3. Performance variance. Explain whether, based on work accomplished to date, you still expect to achieve you performance goals. If not, explain the reason for the variance.

E. **Corrective actions:** If actual work accomplished or costs incurred to date vary from the planned baseline goals by 10 percent or more, explain:

- a. What you plan to do, if anything, to correct project performance.
- b. What effect your action will have on overall projects cost, schedule, and performance benefits.

**Appendix 9.9 AACE Recommended Practice No. 17R-97**

# Recommended Practice No. 17R-97

## Cost Estimate Classification System



August 12, 1997

### PURPOSE

As a recommended practice of AACE International, the Cost Estimate Classification System provides guidelines for applying the general principles of estimate classification to asset project cost estimates. Asset project cost estimates typically involve estimates for capital investment, and exclude operating and life-cycle evaluations. The Cost Estimate Classification System maps the phases and stages of asset cost estimating together with a generic maturity and quality matrix that can be applied across a wide variety of industries.

This guideline and its addenda have been developed in a way that:

- provides common understanding of the concepts involved with classifying project cost estimates, regardless of the type of enterprise or industry the estimates relate to;
- fully defines and correlates the major characteristics used in classifying cost estimates so that enterprises may unambiguously determine how their practices compare to the guidelines;
- uses degree of project definition as the primary characteristic to categorize estimate classes; and
- reflects generally-accepted practices in the cost engineering profession.

An intent of the guidelines is to improve communication among all of the stakeholders involved with preparing, evaluating, and using project cost estimates. The various parties that use project

cost estimates often misinterpret the quality and value of the information available to prepare cost estimates, the various methods employed during the estimating process, the accuracy level expected from estimates, and the level of risk associated with estimates.

Reprinted with the permission of AACE International,  
209 Prairie Ave., Suite 100, Morgantown, WV 25601 USA.  
Phone 800-858-COST/304-296-8444. Fax: 304-291-5728.  
Internet: <http://www.aacei.org> E-mail: [info@aacei.org](mailto:info@aacei.org)  
Copyright © by AACE International; all rights reserved.

This classification guideline is intended to help those involved with project estimates to avoid misinterpretation of the various classes of cost estimates and to avoid their misapplication and misrepresentation. Improving communications about estimate classifications reduces business costs and project cycle times by avoiding inappropriate business and financial decisions, actions, delays, or disputes caused by misunderstandings of cost estimates and what they are expected to represent.

This document is intended to provide a guideline, not a standard. It is understood that each enterprise may have its own project and estimating processes and terminology, and may classify estimates in particular ways. This guideline provides a generic and generally-acceptable classification system that can be used as a basis to compare against. If an enterprise or organization has not yet formally documented its own estimate classification scheme, then this guideline may provide an acceptable starting point.

### **INTRODUCTION**

An AACE International guideline for cost estimate classification for the process industries was developed in the late 1960s or early 1970s, and a simplified version was adopted as an ANSI

Standard Z94.0 in 1972. Those guidelines and standards enjoy reasonably broad acceptance within the engineering and construction communities and within the process industries. This

recommended practice guide and its addenda improves upon these standards by:

1. providing a classification method applicable across all industries; and
2. unambiguously identifying, cross-referencing, benchmarking, and empirically evaluating the multiple characteristics related to the class of cost estimate.

This guideline is intended to provide a generic methodology for the classification of project cost estimates in any industry, and will be supplemented with addenda that will provide extensions and additional detail for specific industries.

Reprinted with the permission of AACE International,  
209 Prairie Ave., Suite 100, Morgantown, WV 25601 USA.  
Phone 800-858-COST/304-296-8444. Fax: 304-291-5728.  
Internet: <http://www.aacei.org> E-mail: [info@aacei.org](mailto:info@aacei.org)  
Copyright © by AACE International; all rights reserved.

**CLASSIFICATION METHODOLOGY**

There are numerous characteristics that can be used to categorize cost estimate types. The most significant of these are degree of project definition, end usage of the estimate, estimating methodology, and the effort and time needed to prepare the estimate. The “primary” characteristic used in this guideline to define the classification category is the degree of project definition. The other characteristics are “secondary.”

Categorizing cost estimates by degree of project definition is in keeping with the AACE International philosophy of Total Cost Management, which is a quality-driven process applied during the entire project life cycle. The discrete levels of project definition used for classifying estimates correspond to the typical phases and gates of evaluation, authorization, and execution often used by project stakeholders during a project life cycle.

Five cost estimate classes have been established. While the level of project definition is a continuous spectrum, it was determined from benchmarking industry practices that three to five discrete categories are commonly used. Five categories are established in this guideline as it is easier to simplify by combining categories than it is to arbitrarily split a standard.

The estimate class designations are labeled Class 1, 2, 3, 4, and 5. A Class 5 estimate is based upon the lowest level of project definition, and a Class 1 estimate is closest to full project definition and maturity. This arbitrary “countdown” approach considers that estimating is a process whereby successive estimates are prepared until a final estimate closes the process.

Reprinted with the permission of AACE International,  
209 Prairie Ave., Suite 100, Morgantown, WV 25601 USA.  
Phone 800-858-COST/304-296-8444. Fax: 304-291-5728.  
Internet: <http://www.aacei.org> E-mail: [info@aacei.org](mailto:info@aacei.org)  
Copyright © by AACE International; all rights reserved.

## DOE Cost and Schedule Estimating Guide – DRAFT February 2003

ESTIMATE CLASS	Primary Characteristic	Secondary Characteristic			
	LEVEL OF PROJECT DEFINITION Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical +/- range relative to best index of 1 [a]	PREPARATION EFFORT Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Screening or Feasibility	Stochastic or Judgment	4 to 20	1
Class 4	1% to 15%	Concept Study or Feasibility	Primarily Stochastic	3 to 12	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Mixed, but Primarily Stochastic	2 to 6	3 to 10
Class 2	30% to 70%	Control or Bid/Tender	Primarily Deterministic	1 to 3	5 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Deterministic	1	10 to 100

**Notes:** [a] If the range index value of "1" represents +10/-5%, then an index value of 10 represents +100/-50%.

[b] If the cost index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%.

Figure 1 – Generic Cost Estimate Classification Matrix

### DEFINITIONS OF COST ESTIMATE CHARACTERISTICS

The following are brief discussions of the various estimate characteristics used in the estimate classification matrix. For the secondary characteristics, the overall trend of how each characteristic varies with the degree of project definition (the primary characteristic) is provided.

Reprinted with the permission of AACE International,  
209 Prairie Ave., Suite 100, Morgantown, WV 25601 USA.  
Phone 800-858-COST/304-296-8444. Fax: 304-291-5728.  
Internet: <http://www.aacei.org> E-mail: [info@aacei.org](mailto:info@aacei.org)  
Copyright © by AACE International; all rights reserved.

### **Level of Project Definition (Primary Characteristic)**

This characteristic is based upon percent complete of project definition (roughly corresponding to percent complete of engineering). The level of project definition defines maturity or the extent and types of input information available to the estimating process. Such inputs include project scope definition, requirements documents, specifications, project plans, drawings, calculations, learnings from past projects, reconnaissance data, and other information that must be developed to define the project. Each industry will have a typical set of deliverables that are used to support the type of estimates used in that industry. The set of deliverables becomes more definitive and complete as the level of project definition (i.e., project engineering) progresses.

### **End Usage (Secondary Characteristic)**

The various classes (or phases) of cost estimates prepared for a project typically have different end uses or purposes. As the level of project definition increases, the end usage of an estimate

typically progresses from strategic evaluation and feasibility studies to funding authorization and budgets to project control purposes.

### **Estimating Methodology (Secondary Characteristic)**

Estimating methodologies fall into two broad categories: stochastic and deterministic. In stochastic methods, the independent variable(s) used in the cost estimating algorithms are generally something other than a direct measure of the units of the item being estimated. The cost estimating relationships used in stochastic methods often are somewhat subject to conjecture. With deterministic methods, the independent variable(s) are more or less a definitive measure of the item being estimated. A deterministic methodology is not subject to significant conjecture. As the level of project definition increases, the estimating methodology tends to progress from stochastic to deterministic methods.

Reprinted with the permission of AACE International,  
209 Prairie Ave., Suite 100, Morgantown, WV 25601 USA.  
Phone 800-858-COST/304-296-8444. Fax: 304-291-5728.  
Internet: <http://www.aacei.org> E-mail: [info@aacei.org](mailto:info@aacei.org)  
Copyright © by AACE International; all rights reserved.

### Expected Accuracy Range (Secondary Characteristic)

Estimate accuracy range is an indication of the degree to which the final cost outcome for a given project will vary from the estimated cost. Accuracy is traditionally expressed as a +/- percentage range around the point estimate after application of contingency, with a stated level of confidence that the actual cost outcome would fall within this range (+/- measures are a useful simplification, given that actual cost outcomes have different frequency distributions for different types of projects). As the level of project definition increases, the expected accuracy of the estimate tends to improve, as indicated by a tighter +/- range.

Note that in figure 1, the values in the accuracy range column do not represent + or - percentages, but instead represent an index value relative to a best range index value of 1. If, for a particular industry, a Class 1 estimate has an accuracy range of +10/-5 percent, then a Class 5 estimate in that same industry may have an accuracy range of +100/-50 percent.

### Effort to Prepare Estimate (Secondary Characteristic)

The level of effort needed to prepare a given estimate is an indication of the cost, time, and resources required. The cost measure of that effort is typically expressed as a percentage of the total project costs for a given project size. As the level of project definition increases, the amount of effort to prepare an estimate increases, as does its cost relative to the total project cost. The effort to develop the project deliverables is not included in the effort metrics; they only cover the cost to prepare the cost estimate itself.

Characteristics

## RELATIONSHIPS AND VARIATIONS OF CHARACTERISTICS

There are a myriad of complex relationships that may be exhibited among the estimate characteristics within the estimate classifications. The overall trend of how the secondary characteristics vary with the level of project definition was provided above. This section explores those trends in more detail. Typically, there are commonalities in the secondary characteristics between one estimate and the next, but in any given situation there may be wide variations in usage, methodology, accuracy, and effort.

Reprinted with the permission of AACE International,  
209 Prairie Ave., Suite 100, Morgantown, WV 25601 USA.  
Phone 800-858-COST/304-296-8444. Fax: 304-291-5728.  
Internet: <http://www.aacei.org> E-mail: [info@aacei.org](mailto:info@aacei.org)  
Copyright © by AACE International; all rights reserved.

The level of project definition is the “driver” of the other characteristics. Typically, all of the secondary characteristics have the level of project definition as a primary determinant. While the other characteristics are important to categorization, they lack complete consensus. For example, one estimator’s “bid” might be another’s “budget.” Characteristics such as “accuracy” and “methodology” can vary markedly from one industry to another, and even from estimator to estimator within a given industry.

### **Level of Project Definition**

Each project (or industry grouping) will have a typical set of deliverables that are used to support a given class of estimate. The availability of these deliverables is directly related to the level of project definition achieved. The variations in the deliverables required for an estimate are too broad to cover in detail here; however, it is important to understand what drives the variations. Each industry group tends to focus on a defining project element that “drives” the estimate maturity level. For instance, chemical industry projects are “process equipment-centric”—i.e., the level of project definition and subsequent estimate maturity level is significantly determined by how well the equipment is defined. Architectural projects tend to be “structure-centric,” software projects tend to be “function-centric,” and so on. Understanding these drivers puts the differences that may appear in the more detailed industry addenda into perspective.

### **End Usage**

While there are common end usages of an estimate among different stakeholders, usage is often relative to the stakeholder’s identity. For instance, an owner company may use a given class of estimate to support project funding, while a contractor may use the same class of estimate to support a contract bid or tender. It is not at all uncommon to find stakeholders categorizing their estimates by usage-related headings such as “budget,” “study,” or “bid.” Depending on the stakeholder’s perspective and needs, it is important to understand that these may actually be all the same class of estimate (based on the primary characteristic of level of project definition achieved).

Reprinted with the permission of AACE International,  
209 Prairie Ave., Suite 100, Morgantown, WV 25601 USA.  
Phone 800-858-COST/304-296-8444. Fax: 304-291-5728.  
Internet: <http://www.aacei.org> E-mail: [info@aacei.org](mailto:info@aacei.org)  
Copyright © by AACE International; all rights reserved.

### Estimating Methodology

As stated previously, estimating methodologies fall into two broad categories: stochastic and deterministic. These broad categories encompass scores of individual methodologies. Stochastic methods often involve simple or complex modeling based on inferred or statistical relationships between costs and programmatic and/or technical parameters. Deterministic methods tend to be straightforward counts or measures of units of items multiplied by known unit costs or factors. It is important to realize that any combination of methods may be found in any given class of estimate. For example, if a stochastic method is known to be suitably accurate, it may be used in place of a deterministic method even when there is sufficient input information based on the level of project definition to support a deterministic method. This may be due to the lower level of effort required to prepare an estimate using stochastic methods.

### Expected Accuracy Range

The accuracy range of an estimate is dependent upon a number of characteristics of the estimate input information and the estimating process. The extent and the maturity of the input information as measured by percentage completion (and related to level of project definition) is a highly-important determinant of accuracy. However, there are factors besides the available input information that also greatly affect estimate accuracy measures. Primary among these are the state of technology in the project and the quality of reference cost estimating data.

*State of technology*—technology varies considerably between industries, and thus affects estimate accuracy. The state of technology used here refers primarily to the programmatic or technical uniqueness and complexity of the project. Procedurally, having “full extent and maturity” in the estimate basis deliverables is deceptive if the deliverables are based upon assumptions regarding uncertain technology. For a “first-of-a-kind” project there is a lower level of confidence that the execution of the project will be successful (all else being equal). There is generally a higher confidence for projects that repeat past practices. Projects for which research and development are still under way at the time that the estimate is prepared are particularly subject to low accuracy expectations. The state of technology may have an order of magnitude (10 to 1) effect on the accuracy range.

Reprinted with the permission of AACE International,  
209 Prairie Ave., Suite 100, Morgantown, WV 25601 USA.  
Phone 800-858-COST/304-296-8444. Fax: 304-291-5728.  
Internet: <http://www.aacei.org> E-mail: [info@aacei.org](mailto:info@aacei.org)  
Copyright © by AACE International; all rights reserved.

*Quality of reference cost estimating data*—accuracy is also dependent on the quality of reference cost data and history. It is possible to have a project with “common practice” in technology, but with little cost history available concerning projects using that technology. In addition, the estimating process typically employs a number of factors to adjust for market conditions, project location, environmental considerations, and other estimate-specific conditions that are often uncertain and difficult to assess. The accuracy of the estimate will be better when verified empirical data and statistics are employed as a basis for the estimating process, rather than assumptions.

In summary, estimate accuracy will generally be correlated with estimate classification (and therefore the level of project definition), all else being equal. However, specific accuracy ranges will typically vary by industry. Also, the accuracy of any given estimate is not fixed or determined by its classification category. Significant variations in accuracy from estimate to estimate are possible if any of the determinants of accuracy, such as technology, quality of reference cost data, quality of the estimating process, and skill and knowledge of the estimator vary. Accuracy is also not necessarily determined by the methodology used or the effort expended. Estimate accuracy must be evaluated on an estimate-by-estimate basis, usually in conjunction with some form of risk analysis process.

### **Effort to Prepare Estimate**

The effort to prepare an estimate is usually determined by the extent of the input information available. The effort will normally increase as the number and complexity of the project definition

deliverables that are produced and assessed increase. However, with an efficient estimating methodology on repetitive projects, this relationship may be less defined. For instance, there are combination design/estimating tools in the process industries that can often automate much of the design and estimating process. These tools can often generate Class 3 deliverables and estimates from the most basic input parameters for repetitive-type projects. There may be similar tools in other industry groupings.

It also should be noted that the estimate preparation costs as a percentage of total project costs will vary inversely with project size in a nonlinear fashion. For a given class of estimate, the preparation cost percentage will decrease as the

<p>Reprinted with the permission of AACE International, 209 Prairie Ave., Suite 100, Morgantown, WV 25601 USA. Phone 800-858-COST/304-296-8444. Fax: 304-291-5728. Internet: <a href="http://www.aacei.org">http://www.aacei.org</a> E-mail: <a href="mailto:info@aacei.org">info@aacei.org</a> Copyright © by AACE International; all rights reserved.</p>
---

total project costs increase. Also, at each class of estimate, the preparation costs in different industries will vary markedly. Metrics of estimate preparation costs normally exclude the effort to prepare the defining project deliverables.

### **ESTIMATE CLASSIFICATION MATRIX**

The five estimate classes are presented in figure 1 in relationship to the identified characteristics. Only the level of project definition determines the estimate class. The other four characteristics are secondary characteristics that are generally correlated with the level of project definition, as discussed above.

This generic matrix and guideline provide a high-level estimate classification system that is nonindustry specific. Refer to subsequent addenda for further guidelines that will provide more detailed information for application in specific industries. These will provide additional information, such as input deliverable checklists, to allow meaningful categorization in that industry.

### **REFERENCES**

ANSI Standard Z94.2-1989. **Industrial Engineering Terminology: Cost Engineering.**

Reprinted with the permission of AACE International,  
209 Prairie Ave., Suite 100, Morgantown, WV 25601 USA.  
Phone 800-858-COST/304-296-8444. Fax: 304-291-5728.  
Internet: <http://www.aacei.org> E-mail: [info@aacei.org](mailto:info@aacei.org)  
Copyright © by AACE International; all rights reserved.

**Chapter 10 - REFERENCES** 

Section 10.1 - Acronyms

Section 10.2 - Definitions

Section 10.3 - References

**Section 10.1 - Acronyms** 

A/E	Architect/Engineer
AACE	American Association of Cost Engineers
ABC	Activity Based Costing
AIP	Agreement in Principle
ANSI	American National Standards Institute
ASTM	American Society for Testing Materials
BA	Budget Authority
BO	Budget Outlay
CDR	Conceptual Design Report
CER	Cost Estimating Relationship
CFO	Chief Financial Officer
CFR	Code of Federal Regulations
CM	Construction Management
COA	Code of Accounts
CPAF	Cost Plus Award Fee (contract type)
CPDS	Construction Project Data Sheet
CPFF	Cost Plus Fixed Fee (contract type)
CSI	Construction Specifications Institute
DOE	U.S. Department of Energy
EIR	External Independent Review

## **DOE Cost and Schedule Estimating Guide – DRAFT February 2003**

---

ESAAB	Energy System Acquisition Advisory Board
ES&H	Environment, Safety, and Health
FP	Fixed Price (contract)
FTE	Full Time Equivalents
GAO	General Accounting Office
GFE	Government Furnished Equipment
LS	Lump-Sum (Contract)
M&I	Management and Integration Contractor
M&O	Management and Operating Contractor
MNS	Mission Need Statement
O&M	Operations and Maintenance
OMB	Office of Management and Budget
OPC	Other Project Cost
PDS	Project Data Sheet
PEP	Project Execution Plan
PM	Project Management
PSAR	Preliminary Safety Analysis Report
QA	Quality Assurance
QC	Quality Control
R&D	Research and Development
SOW	Statement of Work
TEC	Total Estimated Cost
TPC	Total Project Cost
WBS	Work Breakdown Structure

## **Section 10.2 - Definitions**

**Acceptance Testing** - The performance of all testing necessary to demonstrate that installed equipment and/or systems will operate satisfactorily and safely in accordance with plans and specifications. It includes hydrostatic, pneumatic, electrical, ventilation, mechanical functioning, and run-in tests of equipment, portions of systems, and finally of completed systems. (DOE PM Manual)

**Accountability** - The requirement, obligation, or willingness of an individual to accept responsibility for the outcome, results and consequences of their actions and decisions. In a project setting, accountability is inseparable from authority and responsibility. (DOE PM Manual)

**Accounting** - Salaries, travel, and other expenses for account-ants, timekeep-ers, clerks, and their secre-tarial support. This is an indirect cost. (Volume 6 Cost Guide)

**Accrued Cost** - Amounts owed for items or services received, expenses incurred, assets acquired, or construction performed, for which a bill (e.g., progress billing, and other billings) has not yet been received or approved. (DOE PM Manual)

**Accrued Cost** - In an earned-value context accruals represent cost (liability) for work performed, and thus costs incurred, for the reporting period even though the bills have not yet been received. Thus accruals are included in the Actual Cost of Work Performed when reporting performance in the earned value system. It is essential that the accrual methodology be consistent with the time phasing of the Budgeted Cost of Work Scheduled. Note that the time phased Budgeted Cost of Work Scheduled should be consistent with the contractual obligations for procurement of goods and services. (DOE PM Manual)

**Acquisition Performance Baseline (APB)** - A quantitative expression reflecting total scope of a project with integrated technical, schedule, and cost elements. It is the established risk adjusted, time-phased plan against which the status of resources and the progress of a project(s) are measured, assessed, and controlled. It is a federal commitment to OMB and Congress. Once established, baselines are subject to change control discipline (modified). (DOE PM Manual) Includes all cost, schedule, and performance parameters (both objectives and thresholds) for a program/project. It represents the DOE commitment to Congress to assess Total Project Cost (TPC). Key elements in formulating an APB include the integration and assessment of program/project scope, schedule, and cost baselines; a systematic risk analysis, and the development and inclusion of adequate risk allocation to address factors that might cause technical/schedule/cost growth during project performance. Project completion without an increase in the APB thresholds or extending the schedule, is the

primary measure of success in formulating the APB. (DOE PM Manual)

**Acquisition Plan (AP)** - Provides the procurement and contracting detail for elements of a program, project, or system. A formal written document reflecting the specific actions necessary to execute the approach established in the approved acquisition strategy and any appropriate guiding documentation. The AP is performance-oriented and provides the framework for conducting and accomplishing a project following MNS approval. (DOE PM Manual)

**Acquisition Strategy (AS)** - A business and technical management approach designed to achieve acquisition objectives within the resource constraints imposed. It is the framework for planning, directing, contracting, and managing a system, program, or project. It provides a master schedule for research, development, test, production, construction, modification, postproduction management, and other activities essential for success. The AS is the basis for formulating functional plans and strategies (e.g., acquisition strategy, competition, systems engineering, etc.). Once approved, it should reflect the approving authority's decisions on all major aspects of the contemplated acquisition. See acquisition plan. (DOE PM Manual)

**Activity** - An element of work performed during the course of a project. An activity normally has an expected duration, an expected cost, and expected resource requirements. Activities are often subdivided into tasks. (DOE PM Manual)

**Activity-Based Costing (ABC)** - A cost estimating method where the project is divided into discrete activities, and a cost estimate is prepared for each activity. (Volume 6 Cost Guide) Costing in a way that the costs budgeted to an account truly represent all the resources consumed by the activity or item represented in the account. (1/03) (AACE)

**Actual Cost of Work Performed (ACWP)** - Total costs incurred (direct and indirect) in accomplishing an identified element or scope of work during a given time period. See also earned value. (DOE PM Manual)

**Agreement in Principal** - During negotiations not all details may be decided, but an Agreement in Principal may be reached. This occurs when most of the contract language is approved by all parties. There may still be some outstanding items that have not been agreed upon during this phase of negotiations. (Volume 6 Cost Guide)

**Allowance** - An incremental amount (technical margin, cost and schedule contingency) that is made part of an estimate or baseline and is expected to be required/costed when complete. It is normally developed from experience or risk analysis. (DOE PM Manual)

**Bar Chart** - A graphic display of schedule-related information. In the typical bar chart, activities or other project elements are listed down the left side of the chart, dates are shown across the top, and activity durations are shown as date-placed horizontal bars. Also called a gantt chart. (DOE PM Manual)

**Baseline** - A quantitative definition of cost, schedule, and technical performance that serves as a base or standard for measurement and control during the performance of an effort; the established plan against which the status of resources and the effort of the overall program, field program(s), project(s), task(s), or subtask(s) are measured, assessed, and controlled. Once established, baselines are subject to change control discipline (modified). (Volume 6 Cost Guide)

**Basis** - Documentation that describes how an estimate, schedule, or other plan component was developed and defines the information used in support of development. A basis document commonly includes, but is not limited to, a description of the scope included, methodologies used, references and defining deliverables used, assumptions and exclusions made, clarifications, adjustments, and some indication of the level of uncertainty. (1/03) (AACE)

**Beneficial Use or Occupancy Date** - The process by which a facility, portions thereof, or the last piece of principal equipment, is released for use by others, prior to final acceptance. Non-integral or subsidiary items and correction of design inadequacies subsequently brought to light may be completed after this date. On multiple-facility projects, beneficial use of the overall project will be the beneficial use date of the last major building or facility. This activity is always documented and approved by the responsible parties. (DOE PM Manual)

**Breach** - A project breach occurs when the current estimate of a performance, technical, scope, schedule, or cost parameter is not within the threshold value (APB) for that parameter. It is handled as a deviation, not through the normal change control system. (DOE PM Manual)

**Budget at Completion (BAC)** - The total authorized budget for accomplishing the program scope of work. It is equal to the sum of all allocated budgets plus any undistributed budget. (Management Reserve is not included.) The Budget at Completion will form the APB as it allocated and time-phased in accordance with program schedule requirements. (DOE PM Manual)

**Budgeted Cost of Work Performed (BCWP)** - The sum of the approved cost estimates (including any overhead allocation) for activities (or portions of activities) completed during a given period (usually project-to-date). See also earned value. (DOE PM Manual)

**Budgeted Cost of Work Scheduled (BCWS)** - The sum of the approved cost estimates (including any overhead allocation) for activities (or portions of

activities) scheduled to be performed during a given period (usually project-to-date). See also earned value. (DOE PM Manual)

**Budgeting** - A process used to allocate the estimated cost of resources into cost accounts (i.e., the cost budget) against which cost performance will be measured and assessed. Budgeting often considers time-phasing in relation to a schedule and/or time-based financial requirements and constraints. (1/03) (AACE)

**Buried Contingency** - Some estimators have sought to hide contingency estimates in order to protect the project so that the final project does not go over budget because the contingency has been removed by outside sources. This is commonly known as buried contingency. (Volume 6 Cost Guide)

**Capital Assets** - Land, structures, equipment, systems, and information technology (e.g., hardware, software, and applications) that are used by the Federal Government and have an estimated useful life of two years or more. Capital assets include environmental restoration (decontamination and decommissioning) of land to make useful leasehold improvements and land rights, and assets whose ownership is shared by the Federal Government with other entities. This does not apply to capital assets acquired by state and local governments or other entities through DOE grants. Capital Assets do not include intangible assets, such as the knowledge resulting from research and development and education and training. (DOE PM Manual) Strategic Asset. Any unique physical or intellectual property that is of long term or ongoing value to the enterprise. As used in total cost management, it most commonly includes capital or fixed assets, but may include intangible assets. Excludes cash and purely financial assets. Strategic assets are created by the investment of resources through projects. (AACE)

**Change Proposal** - The instrument/document prepared to provide a complete description of a proposed change and its resulting impact on a project's objectives. (DOE PM Manual)

**Code of Accounts (COA)** - A systematic coding structure for organizing and managing asset, cost, resource, and schedule activity information. A COA is essentially an index to facilitate finding, sorting, compiling, summarizing, and otherwise managing information that the code is tied to. A complete code of accounts includes definitions of the content of each account. Syns.: Chart of Accounts, Cost Codes. (1/03) (AACE)

**Conceptual Design Report (CDR)** - The CDR documents the outcome of the conceptual design phase and forms the basis for a preliminary ROM baseline. (DOE PM Manual)

**Conceptual Design** - Conceptual design encompasses those efforts to: (a) develop a project scope that will satisfy program needs; (b) assure project

feasibility and attainable performance levels; (c) develop reliable cost estimates and realistic schedules in order to provide a complete description of the project for Congressional consideration; and (d) develop project criteria and design parameters for all engineering disciplines, identification of applicable codes and standards, quality assurance requirements, environmental studies, materials of construction, space allowances, energy conservation features, health safety, safeguards, and security requirements, and any other features or requirements necessary to describe the project. Conceptual design occurs between Critical Decision-0 and -1. (DOE PM Manual)

**Configuration Management** - The technical and administrative direction and surveillance actions taken to identify and document the functional and physical characteristics of a configuration item; to control changes to a configuration item and its characteristics; and to record and report change processing and implementation status. (DOE PM Manual)

**Construction Completion Date** - The date on which work normally performed by construction forces (including installation of equipment by operating contractors or others) is accepted by the Government. This includes the completion of all building items, the erection and/or installation of mechanical units and/or processing equipment, and the installation of all furnishings as required to make a fully functioning building, facility, or process. Correction of minor deficiencies and exceptions may be accomplished after the recorded date. (DOE PM Manual)

**Construction Management** - Services that encompass a wide range of professional services relating to the management of a project during the pre-design, design, and/or construction phases. The types of services provided include development of project strategy, design review relating to cost and time consequences, value management, budgeting, cost estimating, scheduling, monitoring of cost and schedule trends, procurement, observation to assure that workmanship and materials comply with plans and specifications, contract administration, labor relations, construction methodology and coordination, and other management efforts related to the acquisition of construction. (DOE PM Manual)

**Construction Project Data Sheet (Schedule 44)** - This form is submitted to DOE Headquarters for review and, if approved, the project is included in the budget submitted to the Office of Management and Budget (OMB). The completed conceptual design estimate normally serves as the basis for preparation of this form. (Volume 6 Cost Guide) [Does this need to be changed to OMB Exhibit 300???

**Construction** - Any combination of engineering, procurement, erection, installation, assembly, demolition, or fabrication activities involved in creating a

new facility, or to alter, add to, rehabilitate, dismantle, or remove an existing facility. It also includes the alteration and repair (including dredging, excavating, and painting) of buildings, structures, or other real property, as well as any construction, demolition, and excavation activities conducted as part of environmental restoration or remediation efforts. Construction occurs between Critical Decision-3 and -4. Construction does not involve the manufacture, production, finishing, construction, alteration, repair, processing, or assembling of items categorized as personal property. (DOE PM Manual)

**Contingency** - An amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, and/or effect are uncertain and that experience shows will likely result, in aggregate, in additional costs. Typically estimated using statistical analysis or judgment based on past asset or project experience. Contingency usually excludes; 1) major scope changes such as changes in end product specification, capacities, building sizes, and location of the asset or project (see management reserve), 2) extraordinary events such as major strikes and natural disasters, 3) management reserves, and 4) escalation and currency effects. Some of the items, conditions, or events for which the state, occurrence, and/or effect is uncertain include, but are not limited to, planning and estimating errors and omissions, minor price fluctuations (other than general escalation), design developments and changes within the scope, and variations in market and environmental conditions. Contingency is generally included in most estimates, and is expected to be expended to some extent. (1/03) (AACE) Contingency is that budget held by DOE that is not put on contract. (DOE PM Manual)

**Contract Closeout** - Completion and settlement of the contract including resolution of all outstanding items. (DOE PM Manual)

**Contract Fee** - Fee earned by the contractor. It may be based on dollar value or other unit of measure such as man-hours. This is an indirect cost. (Volume 6 Cost Guide)

**Contract** - A contract is a mutually binding agreement that obligates the seller to provide the specified product and obligates the buyer to pay for it. It includes all types of commitments that obligate the Government to an expenditure of funds and which, except as otherwise authorized, are in writing. (DOE PM Manual)

**Contractor** - Includes all persons, organizations, departments, divisions, and companies having contracts, agreements, or memoranda of understanding with the DOE or other Federal Agency. (Volume 6 Cost Guide)

**Control (Cost) Account** - A management control point at which budgets (resource plans) and actual costs are accumulated and compared to earned value for management control purposes. A control account is a natural

management point for planning and control since it represents the work assigned to one responsible organizational element on one work breakdown structure element and is the lowest level where all three PMB elements are accumulated. (DOE PM Manual)

**Corrective Action** - Changes made to bring expected future performance of the project into line with the plan. (DOE PM Manual)

**Cost Accounting** - The historical reporting of actual and/or committed disbursements (costs and expenditures) on a project. Costs are denoted and segregated within cost codes that are defined in a chart of accounts. In project control practice, cost accounting provides the measure of cost commitment and/or expenditure that can be compared to the measure of physical completion (or earned value) of an account. (1/03) (AACE)

**Cost Budgeting** - Allocating the cost estimates to individual project components. (DOE PM Manual)

**Cost Control** - Controlling changes to the project budget and forecast to completion. (DOE PM Manual)

**Cost Estimate** - A documented statement of costs to be incurred to complete the project or a defined portion of a project. Cost estimates provide input to budget, contract, or project management planning for baselines and changes against which performance may be measured.

**Cost Estimating** - A predictive process used to quantify, cost, and price the resources required by the scope of an asset investment option, activity, or project. As a predictive process, estimating must address risks and uncertainties. The outputs of estimating are used primarily as inputs for budgeting, cost or value analysis, decision making in business, asset and project planning, or for project cost and schedule control processes. (AACE)

**Cost Estimating Relationship (CER)** - In estimating, an algorithm or formula that is used to perform the costing operation. CERs show some resource (e.g., cost, quantity, or time) as a function of one or more parameters that quantify scope, execution strategies, or other defining elements. A CER may be formulated in a manner that in addition to providing the most likely resource value, also provides a probability distribution for the resource value. Cost estimating relationships may be used in either definitive or parametric estimating methods. See DEFINITIVE ESTIMATE and PARAMETRIC ESTIMATE. (1/03) (AACE)

**Cost Plus Award Fee (CPAF) Contract** - A contract where the contractor recovers actual costs incurred for completed work and is awarded a fee based on performance. Actual costs include general administration, overhead, labor and

fringe benefits, other direct costs, and materials, including mark-up. (Volume 6 Cost Guide)

**Cost Plus Fixed Fee (CPFF) Contract** - A type of contract where the buyer reimburses the seller for the seller's allowable costs (allowable costs are defined by the contract) plus a fixed amount of profit (fee). (DOE PM Manual)

**Cost Plus Incentive Fee (CPIF) Contract** - A type of contract where the buyer reimburses the seller for the seller's allowable costs (allowable costs are defined by the contract), plus a fee calculated on the basis of defined performance criteria. (DOE PM Manual)

**Cost Variance** - It is the algebraic difference between earned value and actual cost (Cost Variance = Earned Value - Actual Cost.) A positive value indicated a favorable position and a negative value indicates an unfavorable condition. (DOE PM Manual)

**Costs to Date** - Costs incurred to date by the contractor and reported to DOE, which are recorded as accrued costs. They represent all charges incurred for goods and services received and other assets required, regardless of whether payment for the charges has been made. This includes all completed work and work in process chargeable to the contract. Accrued costs include invoices for: (1) completed work to which the prime contractor has acquired title; (2) materials delivered to which the prime contractor has acquired title; (3) services rendered; (4) costs billed under cost reimbursement, or time and material subcontracts for work to which the prime contractor has acquired title; (5) progress payments to subcontractors that have been paid or approved for current payment in the ordinary course of business (as specified in the prime contract); and (6) fee profit allocable to the contract. (DOE PM Manual)

**Critical Activity** - Any activity on a critical path or with a zero or negative float value. Most commonly determined by using the critical path method. Although some activities are "critical" in the dictionary sense without being on the critical path, this meaning is seldom used in the project context. (DOE PM Manual)

**Critical Decision (CD)** - A formal determination, made by the AE and/or designated official (Mission Need Statement) at a specific point in a project life cycle that allows the project to proceed. Critical Decisions occur in the course of a project. For example: prior to commencement of conceptual design, commencement of execution and prior to turnover. (DOE PM Manual)

**Critical Path Method** - A network analysis technique used to predict project duration by analyzing which sequence of activities (which path) has the least amount of scheduling flexibility (the least amount of float). Early dates are calculated by means of a forward pass using a specified start date. Late dates are calculated by means of a backward pass starting from a specified completion

date to result in zero total float for each activity. (DOE PM Manual)

**Critical Path** - In a project network diagram, the series of logically linked activities that determine the earliest completion date for the project. The critical path may change from time to time as activities are completed ahead of or behind schedule. Although normally calculated for the entire project, the critical path can also be determined for a milestone or subproject. The critical path is usually defined as those activities with float less than or equal to a specified value, often zero. (DOE PM Manual)

**Definitive Estimate** - In estimating practice, describes estimating algorithms or cost estimating relationships that are not highly probabilistic in nature (i.e., the parameters or quantification inputs to the algorithm tend to be conclusive or definitive representations of the scope). Typical definitive estimate algorithms include, but are not limited to, detailed unit and line-item cost techniques (i.e., each specific quantified item is listed and costed separately). (1/03) (ACE)

**Deviation** - A project deviation occurs when the current estimates of cost, schedule, or performance are not within the threshold value established in the APB. See breach. (DOE PM Manual)

**Direct Costs** - Any costs that can be specifically identified with a particular project or activity, including salaries, travel, equipment, and supplies directly benefiting the project or activity. (Volume 6 Cost Guide)

**Duration** - The number of work periods (not including holidays or other non-working periods) required to complete an activity or other project element. Usually expressed as workdays or workweeks. Sometimes incorrectly equated with elapsed time. (DOE PM Manual)

**Earned Value (EV)** - (1) A method for measuring project performance. It compares the value of work performed (Budgeted Cost of Work Performed) with the value of work scheduled (Budgeted Cost of Work Scheduled) and the cost of performing the work (Actual Cost of Work Performed) for the reporting period and/or cumulative to date. See also actual cost of work performed, budgeted cost of work scheduled, budgeted cost for work performed, cost variance, cost performance index, schedule variance, and schedule performance index. (2) The budgeted cost of work performed for an activity or group of activities. (DOE PM Manual)

**Economic Escalation** - Cost increases caused by unit price increases. Whereas the cost of projects can increase because of poor management, scope growth, and schedule delays, economic escalation is concerned only with forecasting price increases caused by an increase in the cost of labor, material, or equipment necessary to perform the work. (Volume 6 Cost Guide)

**External Independent Review (EIR)** - Mandated by congress to be performed for projects of significant size and complexity, which may warrant management attention. (DOE PM Manual)

**Estimate At Completion (EAC)** - The current estimated cost for program authorized work. (EIA-748) (DOE PM Manual)

**Estimate To Complete (ETC)** - Estimate of costs to complete all work from a point in time to the end of the project or program. (DOE PM Manual)

**Expense Funding** - Funding from the Operating Office expense funds. (Volume 6 Cost Guide)

**Facilities** - Buildings and other structures; their functional systems and equipment, including site development features such as landscaping, roads, walks, and parking areas; outside lighting and communications systems; central utility plants; utilities supply and distribution systems; and other physical plant features. (DOE PM Manual)

**Fixed Price Contracts** - Fixed price contracts provide for a firm price or, under appropriate circumstances, may provide for an adjustable price for the supplies or services that are being procured. In providing for an adjustable price, the contract may fix a ceiling price, target price (including target cost), or minimum price. Unless otherwise provided in the contract, any such ceiling, target, or minimum price is subject to adjustment only if required by the operation of any contract clause that provides for equitable adjustment, escalation, or other revision of the contract price upon the occurrence of an event or a contingency. (DOE PM Manual)

**Fixed Price Incentive Fee Contract** - A type of contract where the buyer pays the seller a set amount (as defined by the contract), and the seller can earn an additional amount if it meets or exceeds defined performance criteria. (DOE PM Manual)

**Funding Profile** - A representation of the project costs over the life of the project. (Volume 6 Cost Guide)

**General Plant Projects (GPP)** - Congress has recognized DOE's need to provide for miscellaneous construction items that are required during the fiscal year and which cannot be specifically identified beforehand. Congress provides, annually, an amount for these purposes under the title of General Plant Projects. (DOE PM Manual)

**Government Estimates** - Determines the reasonableness of competitive bids received in connection with fixed-price construction contracts, and serves as a control in evaluating cost estimates prepared by a prime cost-type construction contractor. Sometimes called engineer's estimate. (Volume 6 Cost Guide)

**Improvements to Land** - The cost of general site clearing, grading, drainage, and facilities common to the project as a whole (such as roads, walks, paved areas, fences, guard towers, railroads, port facilities, etc.), but excluding individual buildings, other structures, utilities special equipment/process systems, and demolition, tunneling and drilling when they are a significant intermediate or end product of the project. (Volume 6 Cost Guide)

**Independent Review (IR)** - IRs are critical in assessing the performance and health of projects, providing the opportunity to identify potential problems and risks, and formulate plans to correct problems. An IR is conducted by a non-proponent of the project. The IR may be a science-based or engineering-oriented peer review, a review of the project management structure and interrelationships between key organizational components, a review targeted to a specific issue such as cost or budget, a review covering safety, or a combination thereof. Independent reviews may be combined for efficiency, as appropriate. (DOE PM Manual)

**Indirect Costs** - Costs incurred by an organization for common or joint objectives, and which cannot be identified specifically with a particular activity or project. (Volume 6 Cost Guide)

**Integrated Project Schedule** - An integrated project schedule contains all the elements of the overall project, including the design and engineering, procurement, construction, R&D, safety, environmental, and operations activities. An integrated project schedule would cover pre-authorization through construction activities. (Volume 6 Cost Guide)

**Integrated Project Team (IPT)** - An IPT is a cross-functional group of individuals organized for the specific purpose of delivering a project to an external or internal customer. Team members are representative of all competencies that influence the project's overall performance, safety/quality, scope, schedule, or cost. The IPT should be committed to a common purpose and approach for which they hold themselves mutually accountable. Team members are trained by their home departments/organizations to execute standard processes and exercise technical and/or business judgment within established policies in support of the assigned project. Members of an IPT represent technical, manufacturing, business, contracting and support functions and organizations that are critical to developing, procuring and supporting the product. Depending upon the project needs, the typical IPT membership could include legal, quality, safety, environmental, and technical personnel. In all cases, however, the IPT should include a representative from the contracting function; this may be a CO or the Contracting Officer's Technical Representative. In certain cases, the PM may serve as the Contracting Officer's Technical Representative. All IPT actions and activities are performed under the direction of the PM. If possible, IPT members may be assigned for the length of time

required to complete their IPT assignments. Therefore, depending upon the relative impact of a team competency, team membership may be either full-time or part-time. IPTs are the means through which the acquisition process is implemented. The IPT is the overall project support team having responsibility for pre-project, project development, design/engineering, and construction/remediation activities as appropriate. As a project progresses from Initiation to Transition/Closeout completion, the IPT membership may change in both members and capabilities to remain responsive to project needs and requirements. This flexibility allows the PM to adapt the IPT to meet constantly changing project needs. (DOE PM Manual)

**Integrated Safety Management System (ISMS)** - An overall management system designed to ensure that environmental protection, worker and public safety is appropriately addressed in the planning, design, and performance of any task. (DOE PM Manual)

**Internal Replanning** - Replanning actions for remaining work scope. A normal program control process accomplished within the scope, schedule, and cost objectives of the program. (DOE PM Manual)

**Key Cost Parameters (KCP)** - Identify the total cost of the project (TPC), and in general include direct costs such as research and development, test, construction, remediation, procurement, fabrication, services, transition, and startup. Costs of quality, environment, safety, occupational health as well as the cost of acquisition items procured with operations and maintenance funds and also included, as well as indirect costs not directly attributable to the project but resulting from the project such as infrastructure costs. At a minimum, the TPC and the TEC is a KCP and a KPP, respectively. (DOE PM Manual)

**Key Performance Parameters (KPP)** - A vital characteristic of a project or facility mission. A characteristic, function, requirement, or design basis, that if changed, would have a major impact on the facility or system performance, scope, schedule, cost and/or risk, or the ability of an interfacing project to meet its mission requirements. Thus, a KPP may be a performance, design or interface requirement. Parameters that are appropriate for KPPs are those that express performance in terms of accuracy, capacity, throughput, quantity, processing rate, purity, or others that define how well a system, facility or other project will perform. (DOE PM Manual)

**Key Schedule Parameters (KSP)** - Decision points, major milestones, deliverables, initial operation and other critical system events. Mandatory schedule parameters include all phases of the project, major decision points, and initial operation. Schedule parameters are established through an interactive process that proceeds integrally with the technical and cost processes. Critical path activities, events, milestones and resources are developed using a

disciplined approach and are properly integrated with all other appropriate events. (DOE PM Manual)

**Land and Rights** - The purchase price and other acquisition costs required to obtain the land and/or land rights necessary for a project. This includes removal costs less salvage realized in disposing of any facilities acquired with the land. (Volume 6 Cost Guide)

**Level of Effort (LOE)** - Effort of a general or supportive nature usually without a deliverable end product. An activity (e.g., vendor or customer liaison) that does not readily lend itself to measurement of discrete accomplishment. It is generally characterized by a uniform rate of activity over a specific period of time. Examples are supervision, program administration, and contract administration. Level of Effort tasks receive budgeted cost for work performed, based upon the passage of time, not measured output. (DOE PM Manual)

**Life Cycle Cost (LCC)** - The sum total of the direct, indirect, recurring, nonrecurring, and other related costs incurred or estimated to be incurred in the design, development, production, operation, maintenance, support, and final disposition of a major system over its anticipated useful life span. Where system or project planning anticipates use of existing sites or facilities, restoration, and refurbishment costs should be included. (DOE PM Manual)

**Life Cycle Cost Analysis (LCCA)** - An analysis of the direct, indirect, recurring, non-recurring, and other related costs incurred or estimated to be incurred in the design, development, production, operation, maintenance, support, and final disposition of a major system over its anticipated useful life span. (Volume 6 Cost Guide)

**Life Cycle** - The stages or phases that occur during the lifetime of an object or endeavor. A life cycle presumes a beginning and an end with each end implying a new beginning. In life cycle cost or investment analysis, the life cycle is the length of time over which an investment is analyzed (i.e., study period). (AACE)

**Line-Item Projects** - Projects that are specifically reviewed and approved by Congress. Projects with a total project cost greater than \$5 million are categorized as line item projects. (DOE PM Manual)

**Long-Lead Procurement Items** - Those items of equipment and/or construction materials that require an order date prior to the estimated physical construction start to assure availability at the time needed to avoid delaying the construction performance. (DOE PM Manual)

**Major System (MS) Projects** - Any project or system of projects having a TPC of \$750M or greater, or any other project so designated by the Deputy Secretary. Projects may be classified as MS either solely by the Deputy Secretary or by the

Deputy Secretary in response to recommendations from the appropriate Under Secretary. OECM maintains and periodically publishes a list of MS projects. (DOE PM Manual)

**Management Reserve** - An amount of the total allocated budget withheld for management control purposes, rather than assigned for the accomplishment of a specific task or set of tasks. It is not a part of the Performance Measurement Baseline. (DOE PM Manual)

**Master Schedule** - A summary-level schedule that identifies the major activities and key milestones. See also milestone schedule. (DOE PM Manual)

**Milestone Schedule** - A summary-level schedule that identifies the major milestones. See also master schedule. (DOE PM Manual)

**Milestone** - A schedule event marking the due date for accomplishment of a specified effort (work scope) or objective. A milestone may mark the start, an interim step, or the end of one or more activities. (DOE PM Manual)

**Mission Need** - A required capability within DOE's overall purpose, including scope, cost and schedule considerations. When the mission analysis, or studies directed by appropriate executive or legislative authority, identify a deficiency in existing capabilities or an opportunity, this will be set forth as justification for purposes of system acquisition approvals, planning, programming, and budget formulation. (DOE PM Manual)

**Network Schedule** - A schedule format in which the activities and milestones are represented along with the interdependencies between activities. It expresses the logic (how the program will be accomplished) and the timeframes (when). Network schedules are the basis for critical path analysis, a method for identification and assessment of schedule priorities and impacts. (DOE PM Manual)

**Non-Major System Projects** - Any project or system of projects having a TPC between \$5M and \$750M, or any other project so designated by the Deputy Secretary. (DOE PM Manual)

**Operation** - Ongoing endeavor or activities that utilize strategic assets for a defined function or purpose. (AACE)

**Optimization** - Techniques that analyze a system with the goal of finding an optimum result. Finding an optimum result usually requires evaluating design elements, execution strategies and methods, and other system inputs for their effects on cost, schedule, safety, or some other set of outcomes or objectives. Commonly employs computer simulation and mathematical modeling. (1/03) (AACE)

**Order-of-Magnitude Estimate** - An estimate conducted during the preliminary stages of a project. (Volume 6 Cost Guide)

**Other Project Costs (OPC)** - Costs related to engineering, development, startup, and operations. These activities/costs and allowances are essential for project execution, but are not considered part of the normal capital system/facility acquisition cost. They are operating/expense funded. (DOE PM Manual)

**Parametric Estimate** - In estimating practice, describes estimating algorithms or cost estimating relationships that are highly probabilistic in nature (i.e., the parameters or quantification inputs to the algorithm tend to be abstractions of the scope). Typical parametric algorithms include, but are not limited to, factoring techniques, gross unit costs, and cost models (i.e., algorithms intended to replicate the cost performance of a process or system). Parametric estimates can be as accurate as definitive estimates. (1/03) (AACE)

**Percent Complete (PC)** - An estimate, expressed as a percent, of the amount of work that has been completed on an activity or group of activities. (DOE PM Manual)

**Planning Estimate** - A cost estimate for general planning and budgeting purposes only. Planning estimates will be used when there is a need for an order-of-magnitude estimate, but sufficient definitive information is lacking that would allow the development of a total estimated cost. Planning estimates are developed for each project (program) at the time of project identification. Since these are developed before conceptual design, they are order-of-magnitude only and have the least amount of accuracy and lowest confidence level. Care should be exercised in these estimates to ensure that the order of magnitude is correct, since a tendency exists to avoid changing, particularly upward, this estimate once established. (Volume 6 Cost Guide)

**Preliminary Design** - Continues the design effort utilizing the conceptual design and the project design criteria as a basis for project development. Preliminary design develops topographical and subsurface data and determines the requirements and criteria that will govern the definitive design. Tasks include preparation of preliminary planning and engineering studies, preliminary drawings and outline specifications, life cycle cost analysis, preliminary cost estimates, and scheduling for project completion. Preliminary design provides identification of long-lead procurement items and analysis of risks associated with continued project development. Preliminary design occurs between Critical Decision-1 and -2. (DOE PM Manual)

**Pricing** - In estimating practice, after costing an item or activity, the determination of the amount of money asked in exchange for the item, activity, or project. Pricing determination considers business and other interests (e.g.,

profit, marketing, etc.) in addition to inherent costs. The price may be greater or less than the cost depending on the business or other objectives. In the cost estimating process, pricing follows costing and precedes budgeting. In accounting practice, the observation and recording (collecting) of prices. (1/03) (AACE)

**Productivity** - Consideration for factors that affect the efficiency of construction labor (e.g.: location, weather, work space, coordination, schedule). This is a direct cost. (Volume 6 Cost Guide)

**Program Management** - Management responsibility and authority for specific programs will normally be delegated by the cognizant Program Secretarial Officer. The Headquarters' functions of program management includes planning and developing the overall program; establishing broad priorities; providing policy and broad program direction; preparing and defending the budget; establishing the technical performance, scope, schedule, and cost requirements for projects; controlling DOE Headquarters-level milestones; integrating all components of the program; providing public and private sector policy liaison; expediting Headquarters interface activities and follow-up actions; and retaining overall accountability for program success. The field function includes implementing these program activities, controlling field-level milestones, and providing major support to the Headquarters programming budgeting and processes. (DOE PM Manual)

**Program** - An organized set of activities directed toward a common purpose or goal undertaken or proposed in support of an assigned mission area. A program is characterized by a strategy for accomplishing a definite objective(s), which identifies the means of accomplishment, particularly in quantitative terms, with respect to manpower, materials, and facilities requirements. Programs usually include an element of ongoing activity and are typically made up of technology based activities, projects, and supporting operations. See acquisition program/project. (DOE PM Manual)

**Project Control** - Project Control is a process for controlling the investment of resources in an asset where investments are made through the execution of a project. Project control includes the general steps of 1) project planning including establishing project cost and schedule control baselines, 2) measuring project performance, 3) comparing measurements against the project plans, and ,4) taking corrective, mitigating, or improvement action as may be determined through forecasting and further planning activity. The determination of project progress and status as it relates to the selected schedule is a key element of the process. (AACE)

**Project Data Sheet (PDS)** - A generic term defining the document that contains summary project data and the justification required to include the entire

project effort as a part of the Departmental budget. PDSs are submitted to request PED funds, and construction funds. Specific instructions on the format and content of PDSs are contained in the annual budget call, and DOE O 5100.3, Field Budget Process. (DOE PM Manual)

**Project Engineering and Design (PED)** - A design fund established for program/project use on preliminary design and final baseline development, and/or a statement of work/ request for proposal for a design/build contract. PED funding begins with submission for funds during the pre-project phase and continues through final design completion. PED funds are not to be used for implementation, development, construction, long-lead procurements or major items of equipment. PED fund requirements are developed from historical data or parametric estimates. The objectives for the use of PED funds are to improve the probability of an accurate Performance Baseline for the project; establish the APB after the Preliminary Design is completed; and improve the DOE's Planning, Programming & Budgeting process for the acquisition of capital capabilities. Completed conceptual design is a prerequisite for allocation of PED funds. (DOE PM Manual)

**Project Execution Plan (PEP)** - The PEP is the primary agreement on project planning and objectives between the Headquarters Program Office and the Field, which establishes roles and responsibilities and defines how the project will be executed. The PEP, once approved, becomes a significant tool for the PM through the life of the project. The Headquarters or Field program manager and/or the Federal project manager initiates a PEP. Development of the preliminary PEP can be started by the prime contractor or M&O/M&I at the same time as development of the AS or shortly after. The two plans should be synchronized. If the approved AS indicates that the M&O/M&I contractor has a role in the acquisition of the project as prime contractor/integrator, the M&O/M&I contractor may participate with DOE in development of the final PEP. (DOE PM Manual)

**Project Interface** - A point forming a common boundary between a project and any other project or non-project entity, activity, or service. An interface provides a means or a point of interaction/communication between a project's systems, disciplines and organizations, and those of all other systems, disciplines, and organizations. (DOE PM Manual)

**Project Life Cycle** - A collection of generally sequential project phases whose name and number are determined by the control needs of the organization or organizations involved in the project. (DOE PM Manual) The stages or phases of project progress during the life of a project. Project life cycle stages typically include ideation, planning, execution, and closure. (AACE)

**Project Management Plan (PMP)** - The PMP is the document which sets forth

the plans, organization, and systems that those responsible for managing the project shall utilize. The content and extent of detail of the PMP will vary in accordance with the size and type of project and state of project execution. (Volume 6 Cost Guide)

**Project Management** - A management approach in which authority and responsibility for execution are vested in a single individual, at a level below the general manager, to provide focus on the planning, organizing, directing, and controlling of all activities within the project. PM within DOE requires the skillful application of knowledge, skills, tools, and techniques to project activities in order to meet or exceed stakeholder needs and expectations from a project. In general terms, project management functions include assisting the program manager in preparing Headquarters documents and establishing key milestones and overall schedules. Other activities include developing and maintaining the project management plan; managing project resources; establishing and implementing management systems, including performance measurement systems; and approving and implementing changes to project baselines. (DOE PM Manual)

**Project Schedules** - Schedules may be developed for each phase of the project such as design, procurement, and construction. These schedules would indicate the sequence required to finish the activities during the allotted time. Project schedules may also be used in the performance evaluation of contractors. (Volume 6 Cost Guide)

**Project Support** - Support covers those activities performed by the Operating Contractor for internal management and technical support of the Project Manager. (Volume 6 Cost Guide)

**Project** - In general, a unique effort that supports a program mission, having defined start and end points, undertaken to create a product, facility, or system, and containing interdependent activities planned to meet a common objective or mission. A project is a basic building block in relation to a program that is individually planned, approved, and managed. A project is not constrained to any specific element of the budget structure (e.g., operating expense or plant and capital equipment). Construction, if required, is part of the total project. Authorized, and at least partially appropriated, projects will be divided into two categories: major system projects and other projects. Projects include planning and execution of construction, renovation, modification, environmental restoration, decontamination and decommissioning efforts, and large capital equipment or technology development activities. Tasks that do not include the above elements, such as basic research, grants, ordinary repairs, maintenance of facilities, and operations are not considered projects. See acquisition program/project. (DOE PM Manual)

**Quantification** - In estimating practice, an activity to translate project scope information into resource quantities suitable for costing. In the engineering and construction industry, a take-off is a specific type of quantification that is a measurement and listing of quantities of materials from drawings. Syn.: Take-off. (1/03) (AACE)

### **Range, Cost and Schedule Estimate -**

**Real Property** - Land and/or improvements including interests therein, except public domain land. (DOE PM Manual)

### **Reconciliation -**

**Resource** - In planning and scheduling, a resource is any consumable, except time, required to accomplish an activity. From a total cost and asset management perspective, resources may include any real or potential investment in strategic assets including time, monetary, human, and physical. A resource becomes a cost when it is invested or consumed in an activity or project. (AACE)

**Reviews** - A determination of project or system acquisition conditions based on a review of project scope, cost, schedule, technical status, and performance in relation to program objectives, approved requirements, and baseline project plans. These reviews provide critical insight into the plans, design, cost, schedule, organization, and other aspects of the project. They provide the project and senior management with information on which to base critical and non-critical decisions and to make changes which will increase the project's probability of success. Reviews are authorized by the SAE, AE, PAS responsible line managers, operations/field office manager or Program Managers. In all cases, reviews are based on knowledge of the actual project status, performance, problems, and significant development in both the actual execution activities as well as required institutional approval, licensing, review, and environmental processes. The nature of a review requires a critical approach to reviewing and analyzing the project. This generally requires the reviewers to be outside the project, program, and organization in order to avoid inadvertently biasing the analysis. Examples of review include independent reviews, executability reviews, and independent baseline reviews. (DOE PM Manual)

**Risk Management** - The act or practice of controlling risk. An organized process that reduces the risk of an activity or project which will maximize the potential for success of the activity. (DOE PM Manual)

**Risk** - The combined effect of the probability and consequences of failure of an item expressed in qualitative or quantitative terms. (Volume 6 Cost Guide) An event that might happen to the detriment of a program, project or activity. It is described by the probability that the event will occur and the consequence of the extent of loss from the occurrence. The opposite of a "risk" is an "opportunity"

which also has estimated impact (savings) and probability (likelihood of occurrence). (DOE PM Manual)

**Schedule Control** - Controlling changes to the project schedule and preparing workaround plans to mitigate the impact of adverse results/delays by others. (DOE PM Manual)

**Schedule Variance (SV)** - A metric for the schedule performance on a program. It is the algebraic difference between earned value and the budget (Schedule Variance = Earned Value - Budget). A positive value is a favorable condition while a negative value is unfavorable. The SV is calculated in dollars or work units and is intended to compliment network analysis, not supercede or replace it. (DOE PM Manual)

**Schedule** - A plan that defines when specified work is to be done to accomplish program objectives on time. (DOE PM Manual)

**Scope** - The sum of all that is to be or has been invested in and delivered by the performance of an activity or project. In project planning, the scope is usually documented (i.e, the scope document), but it may be verbally or otherwise communicated and relied upon. Generally limited to that which is agreed to by the stakeholders in an activity or project (i.e., if not agreed to, it is .out of scope.). In contracting and procurement practice, includes all that an enterprise is contractually committed to perform or deliver. Syn.: Project Scope. (1/03) (AACE)

**S-Curve** - Graphic display of cumulative costs, labor hours, or other quantities plotted against time. The name derives from the S-like shape of the curve (flatter at the beginning and end, steeper in the middle) produced on a project that starts slowly, accelerates, and then tails off. (DOE PM Manual)

**Special Equipment** - The installed cost of large items of special equipment and process systems such as vessels, (e.g., towers, reactors, storage tanks), heat transfer systems (e.g., heat exchangers, stacks, cooling towers, de-superheaters, etc.), package units (e.g., waste treatment packages, clarifier packages, sulfurization, demineralization, etc.), and process piping systems. (Volume 6 Cost Guide)

**Standard Equipment** - Items of equipment in which only a minimum of design work is required, such as "off-the-shelf" items. Examples include office furniture, laboratory equipment, heavy mobile equipment, etc. Includes spare parts that are made part of the capital cost. This is a direct cost. (Volume 6 Cost Guide)

**Startup** - Startup covers one time costs incurred by the Management and Operating Contractor during the transition period between the completion of construction and operation of the facility. (Volume 6 Cost Guide)

**Statement of Work (SOW)** - A narrative description of products or services to be supplied under contract. (DOE PM Manual)

**System** - A collection of interdependent equipment and procedures assembled and integrated to perform a well-defined purpose. It is an assembly of procedures, processes, methods, routines, or techniques united by some form of regulated interaction to form an organized whole. (DOE PM Manual)

**Threshold Value** - The value beyond which project performance is seriously degraded. The project becomes too costly, or the project is no longer timely. Also, the difference between the APB and the objective value. Threshold values are set individually for each project based on the characteristics of the project, e.g., maturity, risk, complexity. (DOE PM Manual)

**Total Cost Management** - As defined in AACE International's Constitution and Bylaws; .The effective application of professional and technical expertise to plan and control resources, costs, profitability and risks. Simply stated, it is a systematic approach to managing cost throughout the life cycle of any enterprise, program, facility, project, product, or service. This is accomplished through the application of cost engineering and cost management principles, proven methodologies and the latest technology in support of the management process. Can also be considered the sum of the practices and processes that an enterprise uses to manage the total life cycle cost investment in its portfolio of strategic assets. (AACE)

**Total Estimated Costs (TEC)** - The TEC of a project is the specific cost of the project, whether funded as an operating expense or construction. It includes the cost of land and land rights; engineering, design, and inspection costs; direct and indirect construction costs; and the cost of initial equipment necessary to place the plant or installation in operation, whether funded as an operating expense or construction. In recent years, Congress has authorized amounts for projects exclusive of amounts for the construction planning and design. In these cases, the amount authorized is used as a base for TEC, even though it does not include planning and design costs. These costs are typically capitalized. (DOE PM Manual)

**Total Project Cost (TPC)** - The TPC is synonymous with the cost of the APB. It consists of all the costs included in the Total Estimated Cost (TEC) of a project plus Other Project Costs (OPC) such as pre-construction costs, that include conceptual design and research and development, as well as costs associated with the pre-operational phase, such as training and startup. In budget terms, it is the sum of the technical baseline, schedule baseline, and cost baseline. It includes all research and development, operating, plant, and capital equipment costs specifically associated with project construction and may, when planned, go up to the point of routine operations. (DOE PM Manual)

**Undistributed Budget (UB)** - Budget associated with specific work scope or contract changes that have not been assigned to a control account or summary-level planning package. (DOE PM Manual)

**Validation** - The process of evaluating project planning, development, baselines and proposed funding prior to inclusion of new project or system acquisition in the DOE budget. It requires a review of project planning and conceptual development documentation, as well as discussion with the program or field element and principle contributing contractors to determine the source basis, procedures, and validity of proposed requirements, scope, cost schedule, funding, and so forth. Findings and recommendations resulting from the validation process will be provided for use in the annual budget formulation. (DOE PM Manual)

**Value Engineering / Value Management** - Value engineering is a proven management technique using a systemized approach to seek out the best functional balance between the cost, reliability, and performance of a product or project. (Volume 6 Cost Guide) Value engineering is organized effort directed at analyzing the functions of systems, equipment, facilities, services, and supplies for the purpose of achieving the essential functions at the lowest life cycle cost consistent with required performance, quality, reliability and safety. (DOE PM Manual)

**Work Breakdown Structure (WBS)** - A breakdown of a project into those subelements that define the project. The WBS provides a consistent organization framework throughout the project. (Volume 6 Cost Guide) A product-oriented grouping of project elements that organizes and defines the total scope of the project. The WBS is a multi-level framework that organizes and graphically displays elements representing work to be accomplished in logical relationships. Each descending level represents an increasingly detailed definition of a project component. Project components may be products or services. It is the structure and code that integrates and relates all project work (technical, schedule, and cost) and is used throughout the life cycle of a project to identify and track specific work scopes. (DOE PM Manual)

**Work Package** - A task or set of tasks performed within a control account. (DOE PM Manual)

### **Section 10.3 - References**

#### U. S. Department of Energy (DOE) References:

MA-0063, Cost Guides Volumes 1 through 6, 1982.

DOE Guide 430.1-1, Cost Estimating, 1997.

DOE Order 413.3.1, Program and Project Management for the Acquisition of Capital Assets, 1999.

DOE Manual 413.3, DOE Program and Project Management Manual (Draft), October 2002.

DOE Order 430.1a, Life Cycle Asset Management, 1996.

DOE Order 430.1b, RPAM (Draft), 2003.

DOE Order 5700.2D, Cost Estimating, Analysis, and Standardization (Old DOE Order), June 12, 1992.

DOE Order 130.1, Budget Formulation

DOE Order 520.1, Office of Chief Financial Officer

DOE Order 534.1 Accounting

DOE Order 542.1 Competition in Contracting

DOE Guide 120.1-5 Performance Measurement

#### Other References:

Association for the Advancement of Cost Engineering, International (AACE). Skills and Knowledge of Cost Engineering.

AACE. Transactions.

AACE. Cost Engineers' Notebook.

AACE. Recommended Practices.

Baasel, William D. Preliminary Chemical Engineering Plant Design. Elsevier North-Holland, Inc., New York, 1977.

Beck, James V., and Kenneth J. Arnold. Parameter Estimation in Engineering and Science. John Wiley and Sons, New York, 1977.

Brown, Robert J., Ph.D., and Rudolph R. Yanuck, P.E. Life Cycle Costing: A

Practical Guide for Energy Managers. The Fairmont Press, Inc., Atlanta, Georgia, 1980.

Brown, Robert J., Ph.D., and Rudolph R. Yanuck, P.E. Introduction to Life Cycle Costing. The Fairmont Press, Inc., Atlanta, Georgia, 1985.

Chemical Engineering. Vol. 88, No. 7, McGraw-Hill, April 1981.

Clifton, D. S. and D. E. Fyffe, Project Feasibility Analysis—A Guide to Profitable New Ventures. John Wiley and Sons. New York, New York, 1977.

Cressman, Kenneth, W. E. Gallagher, and T. C. Ponder, Jr. "Cost Components of Uranium Mill Tailings Remedial Action (UMTRA)," September 1988.

Croxton, F. E., D. J. Cowden, and S. Klein, Applied General Statistics, 3d. ed., Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1960.

Ezekiel, M. J. B., and K. A. Fox, Methods of Correlation and Regression Analysis 3d. ed., John Wiley & Sons, Inc., New York, 1959.

Gallagher, Paul F. Project Estimating by Engineering Methods. Hayden Book Company, Inc., New York.

Gambino, A. J. and M. Gartenberg, Industrial R&D Management. National Association of Accountants, New York, New York, 1979.

Graver, C. A., and H. E. Boren, Jr., Multivariate Logarithmic and Exponential Regression Models, The Rand Corporation, RM-4879-PR, July, 1967.

Humphreys, Kenneth K., Ed. Project and Cost Engineers; Handbook. 2nd ed., Marcel Dekker, Inc., New York, 1984.

"Improving Early Cost Estimates." Construction Industry Institute's Best Practices Guide. Implementation Resource 131-2, September 1998.

Institut Francais Du Pétrole, Manual of Economic Analysis of Chemical Processes. McGraw-Hill, Inc., New York, 1981.

Jelen, Frederic C., and James H. Black. Cost and Optimization Engineering. 2nd ed., McGraw-Hill, Inc., New York, 1983.

Johnston, John, Econometric Methods, McGraw-Hill Book Company, Inc., New York, 1963.

Kerzner, Harold, Ph.D. Project Management - A Systems Approach to Planning, Scheduling, and Controlling. 4th ed., Van Nostrand Reinhold, New York, 1992.

Medley, L. G., M. N. Lakumb, and W. Byers. "The Increased Cost of Regulatory Rigor." 1992 AACE Transactions, Volume 1. American Association of Cost

Engineers, Morgantown, West Virginia, 1992.

Merck Index, The. Tenth Edition, Merck and Co., Inc., New Jersey, 1983.

Mood, A. M., and F. A. Graybill, Introduction to the Theory of Statistics, 2d. ed., Mc-Graw-Hill Book Company, Inc., New York, 1963. First edition by A. M. Mood, published in 1950.

Morrill, L. P. and S. H. Popper. "Engineering and Design Models: A Project Management Tool." 1984 AACE Transactions. American Association of Cost Engineers, Morgantown, West Virginia, 1992.

Perry, Robert H., and Don Green. Perry's Chemical Engineers' Handbook. 6th ed., McGraw-Hill, Inc., New York, 1984.

Peters, Max S., and Klaus D. Timmerhaus. Plant Design and Economics for Chemical Engineers. 3rd ed., McGraw-Hill Co., New York, 1980.

Spurr, W. A., and C. P. Bonini, Statistical Analysis for Business Decisions, Richard D. Irwin, Inc., Homewood, Illinois, 1967.

Spurr, W. A., L. S. Kellog, and J. H. Smith, Business and Economic Statistics, Richard D. Irwin, Inc., Homewood, Illinois, 1961.

Tyson, K. W., J. R. Nelson, D. C. Gogerty, B. R. Harmon, and A. Salerno. "Cost Analysis of Prototyping Major Weapon Systems Scheduling Using Neural and Symbolic Processing." Cost Estimating and Analysis - Balancing Technology and Declining Budgets. Springer-Verlag, New York, New York, 1992.

Uppal, K. B., and H. Van Gool. "R&D Phase - Capital Cost Estimating." 1992 AACE Transactions, Volume 1. American Association of Cost Engineers, Morgantown, West Virginia, 1992.

Wallis, W. A., and H. V. Roberts, Statistics, The Free Press, New York, 1963.

Yoslov, S. "Cost Estimating Techniques for Pilot Plants." 1992 AACE Transactions, Volume 1. American Association of Cost Engineers, Morgantown, West Virginia, 1992.

### Public Laws

Asbestos Hazard Emergency Response Act (AHERA). 1986 Act requiring school districts to analyze asbestos problems. (Volume 6 Cost Guide)

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Federal statute (also known as Superfund) enacted in 1980 and reauthorized in 1986, that provides the statutory authority for cleanup of

hazardous substances that could endanger public health, welfare, or the environment. CERCLA addresses the uncontrolled releases of hazardous substances to the environment and the cleanup of former or otherwise inactive waste sites. (Volume 6 Cost Guide)

National Emission Standards for Hazardous Air Pollutants (NESHAP). Clean Air Act limits for release of hazardous pollutants for which no ambient air quality standard is applicable. (Volume 6 Cost Guide)

National Environmental Policy Act (NEPA) of 1969. This Act established the requirement for conducting environmental reviews of Federal actions that have the potential for adverse impact on the human environment. NEPA requires that DOE perform an environmental review, with public participation, of proposed major Federal actions that may have an impact on the human environment. This review usually results in an Environmental Assessment or Environmental Impact Statement. (Volume 6 Cost Guide)

Superfund. The fund set up by CERCLA for cleanup of abandoned hazardous waste sites; a colloquial term used to describe CERCLA. (Volume 6 Cost Guide)

Superfund Amendments and Reauthorization Act (SARA). The 1987 Act amending and reauthorizing CERCLA for responding to hazardous waste sites and increasing the size of the fund. (Volume 6 Cost Guide)

UE D&D Fund

GPRA

GMRA

ITMRA

CFO Act

### Office of Management and Budget (OMB) references:

OMB A-11

OMB A-34

OMB A-94

OMB A-76